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REPORT TO
THE JOINT ARMY-NAVY BOARD
in reference to
ADDITIONAL CROSSINGS OF SAN FRANCISCO BAY

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AUGUST, 1946

Submitted by
THE ALAMEDA COUNTY COMMITTEE
for a
SECOND BAY CROSSING

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A comprehensive overall picture of the Oakland Outer Harbor and Middle Harbor areas, with the $50,000,000 Oakland Army Base and municipal shipping terminals on the left and the $100,000,000 Oakland Naval Supply Depot on the right

ALAMEDA COUNTY COMMITTEE
for a
SECOND BAY CROSSING

DOCUMENTS

Report to

THE JOINT ARMY-NAVY BOARD

Appointed pursuant to House Resolution 529 - 79th Congress
in reference to

ADDITIONAL CROSSINGS OF SAN FRANCISCO BAY

THE ALAMEDA COUNTY COMMITTEE
for a
SECOND BAY CROSSING

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Chairman, Board of Supervisors
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Oakland Chamber of Commerce
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Woodruff & Sampson
Consulting Engineers

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Alameda Co., Calif.
Report to the Joint
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OAKLAND CHAMBER OF COMMERCE

THE INDUSTRIAL CENTER OF THE AMAZING NEW WEST

CHAMBER OF COMMERCE BLDG., 417-14TH STREET ★ TELEPHONE GLENCOURT 7800

OAKLAND 12, CALIFORNIA

The Joint Army-Navy Board
Investigating Necessity for
Additional Crossings of San Francisco Bay

Gentlemen:

We submit herewith a statement of the position of Alameda County in regard to additional crossings of San Francisco Bay. As supporting data for such position, we attach a report by our Consulting Engineers.

This Committee is authorized to speak only for Alameda County and the major cities thereof. However, our position is based on what we believe to be the best interests of the entire Bay Area rather than being restricted to those of Alameda County.

The Army and Navy have major establishments in Alameda County. The facilities of the Port of Oakland, including the Oakland Airport, were largely taken over by the military authorities during the late war. In addition, many private establishments in Alameda County were devoted entirely to the war effort. We assume that one of the responsibilities of the Board will be that of insuring that any additional crossings of the Bay do not interfere with the utility of the above-mentioned facilities or lessen the large investments that have been made therein. We believe the interests of the United States and the entire Bay Area are common. Accordingly, this presentation consists largely of factual data and statements of plans for the development of the Area in the hope that this information may be useful to the Board in reaching its conclusions.

It is quite possible that proposals will be made at these hearings which are not now available to this committee. This committee therefore requests an opportunity to submit a closing statement within thirty days after the conclusion of the hearing. Upon request, we will be pleased to submit any additional information which the Board may request.

Respectfully submitted,

The Alameda County Committee
for a Second Bay Crossing

O. H. Fischer

O. H. Fischer, Chairman

THE ALAMEDA COUNTY COMMITTEE
for a
SECOND BAY CROSSING

SUMMARY

The position of Alameda County in regard to additional crossings of San Francisco Bay may be summarized as follows:

1. The entire Bay Area and, in fact, all of Central and Northern California, is a single economic unit. All indications point to a material growth in population and to the rapid development of the many economic advantages of this unit. By reason of its topography, climate and other conditions, the various components of the Bay Area are naturally complementary to, rather than competitive with, each other. Alameda County does not seek any special advantages at the expense of other units of the Area but, instead, urges that all plans for improvement be based on the best overall development of the whole Bay Area.

2. The San Francisco-Oakland Bay Bridge has been of great benefit to all parts of the area. Its general location was determined by the Hoover-Young Commission, a body similar in many respects to the present Board, after obtaining evidence from all interested parties. In the details of its location, and especially in the location of its vehicular approaches, the California Toll Bridge Authority conferred with representatives of the cities and gave consideration to the views of these representatives. The success of the present bridge results to a considerable degree from such procedure. We suggest that this establishes a precedent which may be followed in the present instance.

3. The present bridge has reached its capacity. With the postwar development that is assured in the Bay Area, the present bridge will be overtaxed before a new one can be completed, even though its construction should start at the earliest possible date.

4. San Francisco Bay is one of the prime assets of the Bay Area. Insofar as navigation interests are concerned, this committee has reviewed the conclusions of the Hoover-Young Commission and those of the Joint Army and Navy Board of 1941. The Committee believes that:

a. Any bridge north of the Oakland Estuary should provide clearances equivalent to, and no more restrictions to navigation than, those of the San Francisco-Oakland Bay Bridge.

b. Any bridge between Hunters Point and the Oakland Estuary should provide adequate clearances for all present and future shipping needs to and from San Leandro Bay.

These conclusions definitely prohibit construction consisting of a causeway in any part of the navigable waters between the United States Government bulkhead lines on either side of the Bay, and limit permissible construction to a high-level bridge or subaqueous tubes. Either would be satisfactory from the standpoint of navigation.

Alameda County has no definite location to propose for the next Bay crossing. A suggestion for such determination has been made above. Since, and largely as a result of, the Hoover-Young Commission, the California Toll Bridge Authority has been established. This Authority has made certain investigations which presumably will be presented at this hearing. Subject to such general restrictions as may be established by the Joint Army-Navy Board and subject, as in the original bridge, to discussion with the communities on both sides of the Bay, we believe the Authority the proper agency to determine details of location. However, we suggest the following general considerations:

The location should be such that:

a. It will take approximately half the future vehicular traffic from the existing bridge.

b. The cost of the bridge and its approaches should be as small as possible. It would be desirable that no toll be collected for Bay crossings. Under existing circumstances, there appears no way of financing a new structure except by vehicular tolls. Obviously, the lower the cost, the sooner both bridges will be toll-free.

c. Provisions must be made for an adequate connection to the City of Alameda. This was not done in the case of the present bridge, with the result that Alameda was not benefited by the bridge as were all other sections of Alameda County. In fact, facilities for commuter travel between Alameda and San Francisco are now inferior to the former ferry service.

d. Interference with the present and proposed development of Oakland Harbor and Airport shall be held to minimum.

5. This Committee sees no need for facilities on the second crossing other than adequate capacity for motor vehicles. We believe the findings of our engineers that there is no economic justification for railway facilities on the proposed crossing are sound. If railroad or other facilities are to be provided, however, it should be shown that:

a. Inclusion of such facilities is in the interests of the Bay Area as a whole;

b. Such facilities do not involve a location that would increase travel time, mileage and operating costs for the average motor vehicle;

c. Amortization of the cost of such facilities will not be met in any degree by motor vehicle traffic, nor will the period of amortization be extended by reason of such additional facilities;

d. Discussion of such facilities and arrangements therefor will not materially extend the time required to place a new crossing in service.

6. Alameda County is unalterably opposed to the so-called Reber Plan, which would:

a. Result in unnecessary restrictions for navigation.

b. Restrict access to the waterfront of the entire county as well as to that of our neighboring counties and thereby destroy the value of the waterfront development, including that made by both public and private agencies.

c. Completely destroy the present fishing, salt and other industries which are now well established and important to the economy of the Bay Area.

d. Place a severe burden on all communities facing the waterfront by reason of increased costs of sewage disposal and disposal of storm water.

e. Waste a vast amount of fresh water which is essential to the development of the Bay Area and entire Central Valley.

Insofar as we are aware, the so-called Reber Plan has never been given any engineering study; but our engineers have done this in sufficient detail to demonstrate beyond all doubt that the proposed project is a wild fantasy.

We trust that the Joint Army-Navy Board may make such findings that this scheme may be dismissed from further consideration.

N B. WOODRUFF
AEL SAMPSON

WOODRUFF & SAMPSON
ENGINEERS

171 SECOND ST.
SAN FRANCISCO 5
DOUGLAS 5397

The Alameda County Committee
for a Second Bay Crossing
c/o Oakland Chamber of Commerce
Oakland, California

Gentlemen:

We submit herewith our report in which we recommend the controls which would determine the location of, and facilities which should be provided in connection with, a second Bay Crossing.

In this report we have devoted very considerable attention to the so-called Reber Plan. We believe this analysis shows conclusively that this plan has no economic justification and would, in fact, be a barrier to the proper economic development of the entire Alameda-Contra Costa County Bay Area. We trust that the facts developed may aid in eliminating the proposal from further consideration.

Respectfully submitted,

WOODRUFF & SAMPSON

By Glenn B. Woodruff
Glenn B. Woodruff

GBW/gcw

A SECOND BAY CROSSING

I INTRODUCTION

The amazing growth, exceeding all estimates, of traffic across the San Francisco-Oakland Bay Bridge has demonstrated the necessity of adequate vehicular crossings across San Francisco Bay. The present bridge has reached its capacity. Present potential traffic is deterred from crossing the Bay because of congestion during rush hours. The present traffic will be materially increased by the increases in population and industrial development which are inevitable during the post war period. Additional vehicular facilities across the Bay are an essential part of such development. These facts have led to the appointment of the Joint Army-Navy Board.

It is not the purpose of this report to make any definite recommendations as to the location of, or as to the facilities which should be provided on a second Bay crossing. This matter is being studied by the California Toll Bridge Authority, which has more complete data than any other agency. Moreover, this Authority is under the necessity of insuring that the second crossing is financed on a basis that does not interfere with its committments on the present bridge and in accordance with its policy of eliminating all tolls at the earliest possible date.

For these reasons this report will be mainly limited to assembling such data as may be helpful to the Joint Army-Navy Board and the Toll Bridge Authority. As an exception to this general statement, an analysis is made of the so-called Reber Plan, which, it is understood, has not been analyzed by the Toll Bridge Authority.

II THE SAN FRANCISCO BAY AREA

Any investigation of a second Bay crossing must necessarily start with an analysis of the area to be served. While all of Central and Northern California are concerned and affected by adequate facilities crossing the Bay, the following data will be restricted to the nine counties (Plate 1), Alameda, Contra Costa, Marin, Napa ,San Mateo, Solano, Sonoma, Santa Clara and San Francisco, surrounding the Bay. By reason of climate, topography and other conditions, these counties naturally complement rather than compete with each other. For this reason, in investigating any improvement that affects the entire area, it may be considered as a single economic unit.

The Bay Area and the possibilities of its economic development have been described in considerable detail by others, including:

Area, Population and Water Consumption of the East Bay Municipal Utility District (6)*
The Master Plan of San Francisco (7)
Economic Aspects of a Salt Water Barrier (14)

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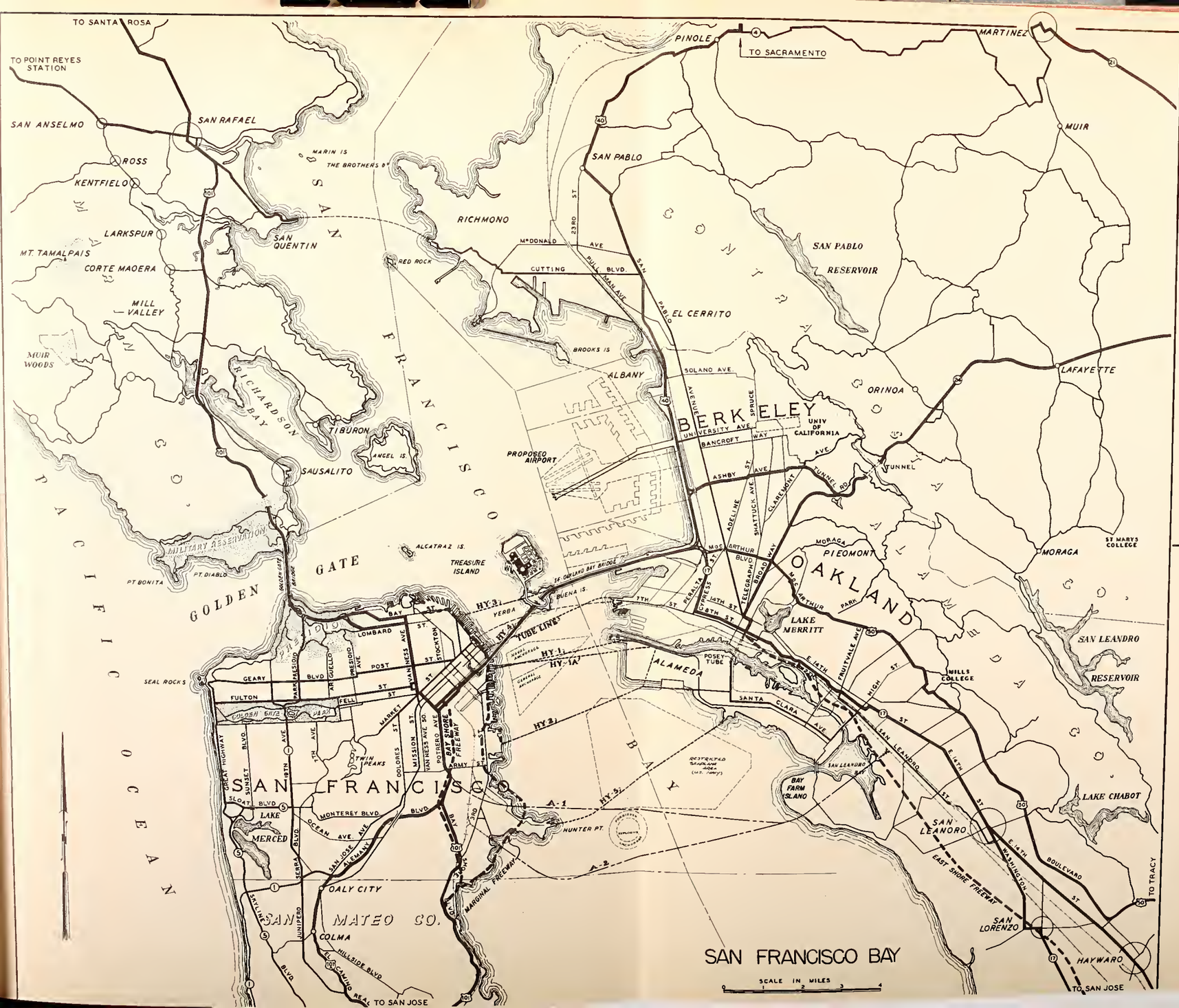
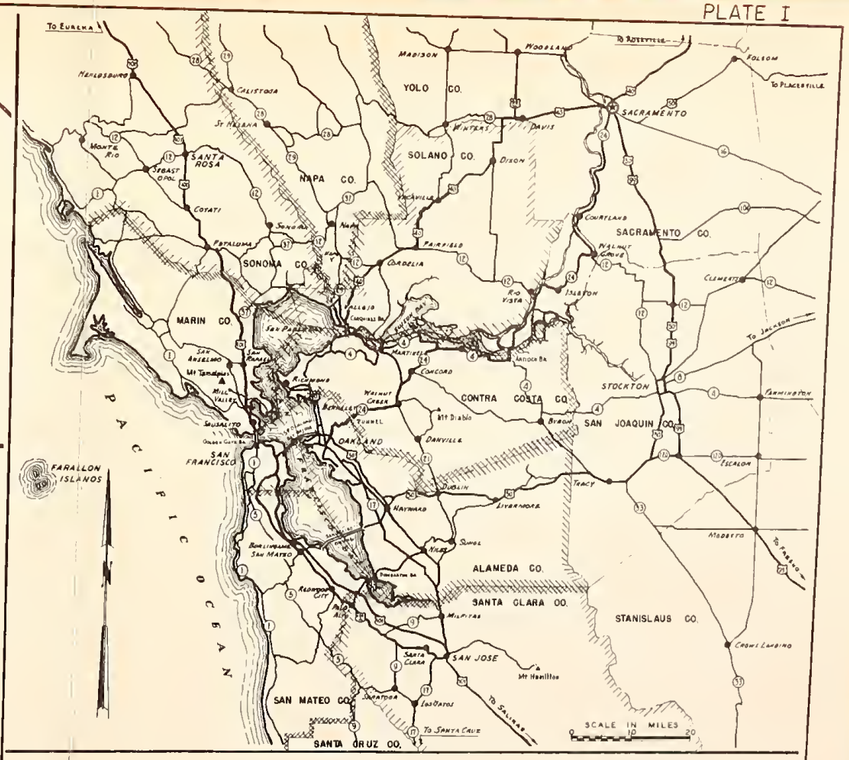
*(6) Throughout this report, references in parentheses are to the Bibliography, Appendix I

PLATE I





NINE BAY COUNTIES

ALAMEDA COUNTY COMMITTEE
FOR THE
SECOND BAY CROSSING

SAN FRANCISCO BAY
NINE BAY COUNTIES

WOODRUFF & SAMPSON
ENGINEERS

The descriptions, statistics, and other material given below are taken largely from such sources. Because of the availability of this material, data are condensed to a greater extent than would otherwise be desirable.

Geography

The Bay Area has a land area of 6,988 square miles with a length in a northwest and southeast direction of 160 miles and a width extending in from the coast line of 50 miles or more. San Francisco Bay is the most prominent feature of this area and large parts of the region are covered by the waters of the Bay and adjacent Pacific Ocean. San Francisco Bay is the largest harbor on the Pacific Coast, having a maximum width of 13 miles, a total length of 60 miles, a total area of 420 square miles, and a shore line of about 350 miles. The area exceeding 30 feet in depth at low water is about 190 square miles.

Beginning at San Francisco and following the southern end of the Bay, thence northward on the east shore to Richmond, there is a narrow coastal plane with adjoining tide lands. Most of the population, industry and urban development of the region is concentrated here. The cities lying in this narrow strip include Alameda, Albany, Berkeley, Emeryville, Hayward, Oakland, Richmond, San Francisco, San Jose, San Leandro and San Mateo, together with smaller cities, towns and villages. The other important communities are located in the regions north of the Bay or along Carquinez Strait, and include Antioch, Benicia, Martinez, Napa, Pittsburg, San Rafael and Vallejo. The entire region is the second largest center of commercial activity on the West Coast of the United States.

The San Francisco Bay Area is at the outlet of the great Central Valley of California which has a total length of 450 miles and a width of 50 miles. Originally the Central Valley was largely a desert, but under irrigation it has developed into a region of unbelievable fertility. The Valley is flanked on the east by the Sierra-Nevadas and on the west by the lower Coast Range. Midway between Mt. Shasta and Tehachapi Pass, the Coast Range is breached by the Golden Gate, permitting an outlet from this inland valley through San Francisco Bay into the Pacific Ocean. The Bay and its upper extension (San Pablo and Suisun Bays) make this inlet one of the great harbors of the world.

Through this outlet in the Coast Range, the drainage of the great Central Valley and its encircling mountains finds its way to the Pacific Ocean. The total drainage area is about 42,000 square miles of the total area of 156,800 square miles in the State of California, and the water flowing through the outlet of the Sacramento-San Joaquin River system comprises 50% of the water of the State.

The Bay Area naturally divides itself into six parts. Each of these parts will be described separately.

1. San Francisco Peninsula
2. Santa Clara Valley
3. Marin Peninsula
4. Area north of Carquinez Straits
5. Area east of San Francisco Bay
6. San Francisco Bay

1. San Francisco Peninsula: The San Francisco Peninsula, including the areas in San Francisco and San Mateo Counties, is divided into two parts by Merced Valley. The highest elevation in the northern block is San Bruno Mountain. The crest of the southern block is at Scarper Peak. The San Andreas fault, one of the most active fault zones in California, passes between these two mountain blocks. San Mateo Creek cuts through the eastern portion of this ridge and drains the San Andreas rift valley into San Francisco Bay. San Andreas and Crystal Springs Lakes of the San Francisco water supply are located in this rift valley.

The topography of the northern end of the Peninsula, although hilly, is sufficiently level for intense urban development. The bay shore in San Mateo and Santa Clara Counties south to Palo Alto and San Jose is gently sloping, but, except at its southern end, is narrower than the east shore of the Bay. On the ocean side of the Peninsula, steep cliffs with sandy beaches at their base, front the ocean.

2. Santa Clara Valley: Santa Clara Valley, at the south end of San Francisco Bay, is an extension of the structural valley of the Bay. The Coyote River with its many side tributaries is the principal stream draining the valley. These water courses discharge into the tidal marshes at the head of the Bay. Along the axis of the valley, the ground surface rises on a gentle slope to the southeast. The soils of the valley floor comprise some of the finest agricultural lands in the Bay Region. At its southern end, a low divide separates the Coyote River drainage from the head waters of the Llagas Creek, a tributary of the Pajaro River. Santa Clara Valley is flanked on the east by the high mountains of the Diablo Range. On the west lie the Santa Cruz Mountains.

3. Marin Peninsula: Sonoma and Marin Counties have been grouped together under the heading of the Marin Peninsula. In some respects, the two counties are quite different in topographic features. Marin County itself is characterized by the large mountain mass centered around Mt. Tamalpais. From this peak and from along the crest of the ridge, the surface has steep slopes on all sides with alternating canyons and steep-crested transverse ridges. On the bay shore, the canyons open out into flat valley floors largely occupied by salt marshes. The western slope is even steeper with a few narrow valleys occupied by deeply entrenched streams.

In Sonoma County the central portion is occupied by gently sloping valleys surrounding the rolling hills. It offers a large area available for settlement. The valleys of Sonoma and Petaluma Creeks drain to the southeast and enter San Pablo Bay. In the northern part of the county, the Russian River flows southeast, joining Mill Creek which drains an area between the Russian River and the headwaters of Petaluma Creek. After the junction of the two streams, the drainage passes through a gap in the Coast Range and flows westward into the Pacific Ocean.

4. Area North of Carquinez Strait: The area north of Carquinez Strait embraces a belt of hilly country in Solano and Napa Counties. The ridges trend generally northwest and southeast and form continuations of the Contra Costa hills and of the Diablo Range to the south of the Strait. On the east the area opens into the gently sloping plains of the lower Sacramento Valley.

To the west is the long narrow flat-bottomed Napa Valley through which flows the Napa River. In the east portion of Napa County lies Berryessa Valley surrounded by mountains. Putah Creek, rising on the east slopes of Mt. St. Helena, flows through this valley and discharges through a narrow canyon located in a gap in the easterly range of hills entering the Sacramento Valley at Winters. North of Carquinez Strait there is an extensive area of gently sloping land separated by low hills and rolling topography. Suisun Valley occupies the eastern area drained by Suisun Creek, Lodgewood Creek, and other small intermittent streams. The Southern portion of this valley forms an extensive marsh area around the northern shore of Suisun Bay.

5. Area East of San Francisco Bay: The area east of San Francisco Bay, located in Alameda and Contra Costa Counties, embraces a belt of hilly country lying between the Bay and the east flank of Mt. Diablo. The ridges trend generally northwest and southeast. The westerly group is designated as the Contra Costa Hills, while the easterly group is called the Mt. Diablo Range. Around the edge of these mountain masses are located two wide valleys. The first and most important area is the east shore region of the valley of San Francisco Bay, occupied by the Alameda-Contra Costa County Cities extending from Hayward to Richmond. The second relatively level area is in Ygnacio Valley lying between the Contra Costa Hills and Mt. Diablo. It extends on a very flat slope northward to Suisun Bay and is drained by Walnut Creek and its tributaries. The southern end of this valley is connected by the narrow flat-bottomed San Ramon Valley opening into the broad Livermore Valley in the drainage area of Alameda Creek.

The Contra Costa Hills group covers a strip of 8 to 10 miles in width between the east shore of San Francisco Bay and the Ygnacio Valley. Several well-defined valleys exist in the Contra Costa Hills Area: San Pablo, Moraga, Lafayette, Pinole, and Arroyo del Hambre Valleys being the most important. The eastern portion is very hilly and not well suited to urban development.

6. San Francisco Bay: Throughout its existence the harbor has been developed as rapidly as good judgment and economics permitted. At the present time, there are plans for extensive improvement on both sides of the Bay. In San Francisco the State Harbor Commission has started on an extension of Pier 50 to Mission Rock, and the construction of wharves around the Rock, which will add six full size steamer berths to the facilities of the harbor.

The present facilities on the east side of the Bay and also the program for their extension are given in more detail in Section IV of this report.

LAND USE

The preeminence of the Bay Area as one of the great ports of the country is assured by its magnificent position, the wealth of its "back-country," and its command through the east shore of trans-Pacific and transcontinental shipping routes. Three transcontinental railroad systems - Southern Pacific, with two transcontinental lines, the Atchison Topeka and Santa Fe, and the Western Pacific - connect the Bay Area with other parts of the United States. The Northwestern Pacific joins the area with the territory on the north California coast.

City and County of San Francisco: San Francisco is the financial center for the region and is the location of the executive offices of most of the large enterprises operating within the boundaries of the nine counties. This city also has an important industrial area, but its industries have selected their location largely because of the proximity of the local market. The existence of deep water at San Francisco has fostered industries which derive their products from abroad and distribute them throughout the large urban area.

San Mateo County: Only a limited area is available in San Mateo County for urban development. Along the bay shore there are about 37,000 acres suitable for urban and industrial growth. In the remainder of the county, principally along the ocean shore, there are about 25,000 acres that will eventually have a suburban growth. In San Mateo County south to Redwood City, reclamation would make other areas available for waterfront industries. At the present time, the only area which has developed to any extent is in the vicinity of South San Francisco. Here are located industries of the heavier type that require ample acreage at moderate cost for large-sized plants.

Santa Clara County: Around San Jose there are about 155,000 acres of urban and agricultural land in Santa Clara Valley of which only 20,000 acres may be classed as available for urban and industrial development. The latter acreage is in the northern part of the County between Palo Alto and San Jose. A deep-water channel at the lower end of the Bay has been projected as an outlet for the products of Santa Clara County and other adjacent territory. The Santa Clara Valley has such an extensive agricultural development and is so well suited for this purpose that it appears probable that its future lies in continued development along agricultural and residential lines. However, a large industrial development centering around San Jose has started and it is expected that this area will become one of the major industrial areas of the nine bay counties.

Marin and Sonoma Counties: The area in Marin County open for urban and suburban development is definitely limited. It is estimated that there are 10,000 acres in the above classification with an additional 21,000 acres that will develop as rural lands. The areas in Sonoma County favorable for settlement are largely agricultural, and due to the relatively isolated position with respect to rail and water transportation, the county will retain in the main its present character. Residential growth will increase at moderate rates as the population around the Bay continues to expand. There are 8,000 acres in Sonoma County suitable for urban and suburban development and 150,000 acres of rural lands.

Solano and Napa Counties: Some of the marshy land around the northern

shore of Suisun Bay has been reclaimed by levees and nearly all of this low ground is susceptible to reclamation. Much of Solano County will remain agricultural in character, but industries will develop along the north shore of Carquinez Strait between Vallejo and Benicia, and adjacent to the main line of the Southern Pacific Railroad which traverses the western edge of the Suisun marshes; also along the Sacramento Northern Railroad following along the eastern boundary of these marshes. Because of the wide areas of marsh land and shallow water prevailing along the northern shore of Suisun Bay, industrial development is improbable in this location.

The western area is occupied by the flaring flat valley floor of the Napa River which discharges into a maze of sloughs crossing the salt marshes bordering the north shore of Suisun Bay. Mare Island Navy Yard is located on the right bank of the mouth of the Napa River. Napa, which is located at the head of navigation on the Napa River, may also experience some industrial development. It is estimated that the urban and suburban land embraces 15,000 acres in N apa County and 20,000 acres in Solano County, while the rural area occupies 72,000 acres in Napa County and 70,000 acres in Solano County.

Alameda and Contra Costa Counties: A careful study of the region around San Francisco Bay shows that areas in which urban development has developed lie mainly in relatively level or rolling areas below 300 ft. altitude. Areas at higher elevations have not developed because of the steep slopes of the hills throughout most of the mountainous region. Exceptions exist in certain relatively level valleys and on plateaus at higher elevations. In Alameda and Contra Costa Counties, there are about 175,000 acres suitable for urban, suburban and industrial development. The largest portion of this area (165,000 acres) lies below 300 feet altitude. In the southern portion of Alameda County along the bay shore, in the Livermore Valley, and the northern portion of San Joaquin Valley in eastern Contra Costa County, there exist 100,000 acres more, suitable for rural development.

In the urban industrial territory, four distinct areas exist. The first, occupied by Oakland, Berkeley, Alameda and adjacent and nearby cities, is already highly developed and approaching population saturation. The present development of industries on the east of the Bay is concentrated here. Port facilities have been developed in recent years, but there is great opportunity for further development by reclamation of tidal flats around San Leandro Bay and between the Bay Bridge approach and the southern boundary of Richmond.

The second area is located north of the above district and extends from Richmond to Rodeo. This territory is developing rapidly and has a very good prospect of continued growth in the postwar period. In Richmond, a channel 32 feet in depth has been constructed, furnishing attractive sites for industries requiring deep water. A large potential area exists between Point San Pablo and Pinole Point. Its development would require bulkheading and filling of tide flats, but would make available an excellent industrial area for plants requiring large areas free from obstruction, easily accessible to deep water, and in close proximity to a good labor supply.

The third region of development is in the Hayward-Niles-San Lorenzo area. This territory is also growing rapidly and the proposed East Shore Highway will hasten the growth. This region, located towards the southern part of the Bay where shallow water exists along the shoreline, will be mainly residential.

The fourth area is located in the Ygnacio Valley and along the shores of Carquinez Strait and Suisun Bay as far east as Antioch. In this region, to a comparatively greater degree than in any other location in the Bay Area, is located inexpensive land facing deep water. Large tracts suitable for heavy industries are still available away from centers of population. The Southern Pacific and Santa Fe Railroads follow along the Contra Costa shoreline, while the Western Pacific, through its ownership of the Sacramento Northern, provides rail service connection in a northerly-southerly direction across the area. This upper Bay Region is better adapted to making products intended for distribution by water and rail over a wide area than for providing populations in the large urban centers with goods that they can consume directly.

Summary of Land Use in the San Francisco Bay Area: The summary of land use in the nine San Francisco Bay Counties is tabulated below:

Location	Classification	Acres
San Francisco	Urban and Industrial	22,000
San Mateo Peninsula	Urban and Industrial	37,000
San Mateo Peninsula	Suburban	25,000
Santa Clara Valley	Urban and Industrial	20,000
Santa Clara Valley	Rural	135,000
Marin County	Urban and Suburban	10,000
Marin County	Rural	21,000
Sonoma County	Urban and Suburban	8,000
Sonoma County	Rural	150,000
Napa County	Urban and Suburban	15,000
Napa County	Rural	72,000
Solano County	Urban and Suburban	20,000
Solano County	Rural	70,000
Alameda and Contra Costa	Urban, Suburban and Industrial	175,000
Alameda and Contra Costa	Rural	100,000

Total area of all classifications - - - - - - - - - - - - - 880,000 Acres.

From the above table the classification of urban, suburban and industrial acreage in the Alameda-Contra Costa County Area is 175,000 acres as compared with a total acreage in the same classification for all the remaining territory in the San Francisco Bay Area of 157,000 acres.

Population

The recorded and estimated population of the nine Bay counties as given by Hall (8) is shown by Table I. For comparison, similar estimates to 1970 in the Master Plan of San Francisco (12) are also given.

The Hall estimates have been based on a most comprehensive study and probably have a better foundation than those of the Master Plan.

The former estimates have therefore been adopted. Both of the above estimates were made at a time when most economists and statisticians were predicting a severe drop in business activity shortly after the close of hostilities. With the demand for additional housing and other developments in the area, it is assured that such will not prove the case. It has been assumed, Figure I, that there will be a gradual increase from the 1946 population to that estimated by Hall in 1960.

Industries and Income

Total estimated income for the San Francisco Bay Area amounted to more than $3,776,000,000 in 1944. Trade at retail in 1944 was estimated at $1,760,931,000 and trade at wholesale more than $3,413,800,000. Waterborne commerce of San Francisco Bay amounted to 30,800,000 tons with an estimated value of $1,480,000,000 for 1940.

The Bay Area ranked first on the Pacific Coast in peacetime waterborne commerce, and third in the nation. Following Pearl Harbor, the area cleared more military cargo than any other port in the nation. At the height of the nation's war shipbuilding program, the Bay Area was foremost. And, as the war in the Pacific ended, the San Francisco Port of Embarkation, so recently designated by its commanding general as "the most important port in the world," was operating at new highs.

Despite the foregoing impressive statistics, it is almost certain that this Area is just starting an era of intensive industrial expansion. In the past the Area has been an "importer" of most industrial products. During the war it became "of age" and is equipped to take its place as a manufacturing center for the Pacific Coast and the Orient.

TABLE I

BAY AREA POPULATION
(Population in Thousands, Recorded and Estimated)

(a) Estimated by L. S. Hall, East Bay M. U. D.

Year	Alameda	Contra Costa	Marin	Napa	San Francisco	San Mateo	Santa Clara	Solano	Sonoma	Total 9 Counties
1860	9	5	3	6	57	3	12	7	12	114
1870	24	8	7	7	150	7	26	17	20	266
1880	63	13	11	13	234	9	35	18	26	422
1890	94	14	13	16	299	10	48	21	33	548
1900	130	18	16	16	343	12	60	24	39	658
1910	246	32	25	20	417	26	84	28	48	926
1920	344	54	27	21	507	37	101	41	52	1,184
1930	475	79	42	23	634	77	145	41	62	1,578
1940	513	101	53	29	635	112	175	49	69	1,736
1946*	743	257	76	43	800	183	229	127	85	2,543
1950	653	237	71	47	717	160	249	110	106	2,350
1960	777	377	87	67	757	226	313	157	139	2,900
1970	928	543	105	87	763	304	385	210	175	3,500
1980	1,095	689	123	107	779	373	459	262	213	4,100
1990	1,286	864	144	134	787	456	547	323	259	4,800
2000	1,524	1,053	168	162	801	549	655	386	302	5,600
					(b) Master Plan of San Francisco					
1950	700	190	85	45	760	160	200	90	80	2,310
1960	780	220	95	48	790	190	230	102	88	2,543
1970	850	240	100	50	800	210	240	111	95	2,696

* California Taxpayers' Association Estimates

TABLE II

POPULATION AND LAND AREAS - ALAMEDA COUNTY

City	Land Areas - Acres			Population		
	1946	1970	2000	1946	1970	2000
Oakland	34,248	35,147	35,945	400,395	475,350	579,090
Alameda	5,248	6,115	6,942	89,906	92,840	126,750
Albany	1,024	1,574	1,854	14,873	19,540	24,390
Berkeley	6,040	7,115	8,598	103,315	118,070	137,520
Emeryville	659	990	1,335	3,800	6,880	9,500
Piedmont	1,152	1,152	1,152	10,678	12,230	13,650
	48,371	52,093	55,826	622,967	724,910	890,900
Outlying Areas				120,033	203,090	633,100
Alameda County				743,000	928,000	1,524,000

TRANSPORTATION

A vast transportation network, including transcontinental rail and highway facilities, air transport services, and steamship lines, converge in the Bay Area, bringing unexcelled transportation to local industry and business. The entire area functioned as one of the outstanding strategic distribution centers in connection with the war effort. Its fortunate geographic position on the Pacific Coast, combined with excellent distribution facilities, makes it possible for business and industry located here to serve a larger portion of the Western markets at lower distribution costs than can be reached from any other Pacific Coast point.

Rail

The area is served directly by four Class I railroads operating more than 27,000 miles of line. These railroads, with their connections, thoroughly blanket California and neighboring States, and by means of seven major transcontinental routes and connecting routes provide fast, dependable service to and from all parts of the United States, Canada and Mexico. Passenger trains second to none are operated to and from the area.

Water

Normally the Bay Area is served by some 177 lines radiating to the major ports in the Orient, the Antipodes, the South Sea Islands, both coasts of Central and South America, Northern and Southern Europe, and Africa. Direct service is normally available at frequent intervals to the West Indies, to all the major ports on the Atlantic and Gulf Coasts, and to major ports on the Pacific Coast. A huge fleet of shallow draft vessels navigates San Francisco Bay and its tributary waters, carrying an immense tonnage to and from the ultra-modern docks.

Highway

Over forty common carrier truck lines provide scheduled service between the Bay Area and points in California and neighboring States. In addition, more than six hundred truck operators, with headquarters or agencies in the Area, hold intrastate contract carrier, radial common carrier, or city carrier permits from the Railroad Commission of California, or interstate contract carrier permits from the Interstate Commerce Commission.

Bus lines radiate north, east and south providing fast, commodious service between the Area and all important points in California and the eleven Western States. There are also four transcontinental bus services.

Plans for increasing the capacity of the main highways have been made. The main concentration is the Eastshore Freeway from Oakland to San Jose on the east side of the Bay and the Bayshore Freeway from San Francisco to Redwood City on the west side of the Bay. Other important contemplated improvements are the Contra Costa Industrial Highway from Richmond to Pittsburg and the completion of the program to provide two lanes in each direction on the highway to Sacramento.

Air

The area has two important air terminals: Oakland Airport, owned and operated by the Port of Oakland, which will be described in more detail later, and San Francisco Municipal Airport. At the latter airport a $20,000,000 improvement program is now under way.

III ALAMEDA COUNTY - METROPOLITAN OAKLAND

For several reasons, one of which was that the mud flats along the eastern shore of the Bay made the development of harbor facilities relatively expensive, the development of Alameda County proceeded more slowly than did that of San Francisco. Starting at the turn of the century there was a reversal of this trend, so that since 1900 the growth of Alameda County, both in population and in industries, has been more rapid than that of San Francisco. The studies of population and land use given above indicate that this trend will continue.

This development has proceeded along sound economic lines, assisted to no small degree by the natural advantages of its location. A water supply, with certain additions as they become necessary from the Sierras, solves this problem for all time to come. Harbor facilities have been provided as rapidly as they were required and plans for their extension have been made. The advantages of the area may be summarized:

Central location on mainland side of San Francisco Bay, midway of Pacific Coast;
Most favorable location for quick, low-cost distribution to the Coast and the eleven western states;
Mainland terminus of three transcontinental railroads;
Deep-water world port, strategic location for postwar trade with the Orient and the world;
Ocean and river terminals unexcelled on the Coast;
Airways center of the west;
Largest power pool in the west;
Low-cost electricity, natural gas, fuel oil and water;
Huge supply of skilled labor;
Factory sites to meet every requirement, on, or close to, rail and water transportation;
191 nationally-known manufacturers, hundreds of others;
Greatly expanded markets, greatest increase in population of four main sections of United States;
Equable climate most favorable for working, hence greater output.

This area (Plate II) includes the cities of Alameda, Albany, Berkeley, Emeryville, Hayward, Oakland, Piedmont and San Leandro; the incorporated towns of Livermore and Pleasanton; and the rural communities of Alameda County. The eight cities form a continuous community extending for 23 miles along the mainland side of San Francisco Bay.

PLATE II

ALAMEDA COUNTY COMMITTEE FOR THE SECOND BAY CROSSING

ALAMEDA COUNTY

PERMANENT MILITARY ESTABLISHMENTS

1. U. S. NAVAL AIR STATION, ALAMEDA
2. U. S. NAVAL AIR TRANSPORT SERVICE, ALAMEDA
3. U. S. ARMY PORT OF EMBARKATION, OAKLAND
4. U. S. ARMY CAMP JOHN T. KNIGHT, OAKLAND
5. U. S. NAVAL SUPPY DEPOT, OAKLAND
6. U. S. NAVAL AUXILIARY BASE, OAKLAND
7. U. S. COAST GUARD BASE, GOV'T. ISLAND, ALAMEDA
8. U. S. MARITIME SERVICE OFFICERS SCHOOL, ALAMEDA
9. U. S. ARMY INTRANSIT DEPOT, ALAMEDA
10. U. S. NAVAL AIR STATION, LIVERMORE
11. U. S. NAVAL HOSPITAL, OAKLAND
12. U. S. NAVAL TRAINING STATION, TREASURE ISLAND

SCALE
0 1 2 3 4 5 MILES

BAY OF SAN FRANCISCO

CONTRA COSTA COUNTY

SAN JOAQUIN CO.

SANTA CLARA CO.

WOODRUFF & SAMPSON ENGINEERS

The population and land use areas of Metropolitan Oakland at present and with estimates (by Hall (8)) are shown by Table II. The estimated land increases are from tideland reclamation that appears probable in the comparatively near future.

Master Plan. The County of Alameda, all of its major cities and the Port of Oakland, in cooperation with the State Highway Department insofar as transportation is involved, are preparing a coordinated Master Plan in order that these advantages may be utilized to the greatest benefit of the Bay Area.

Among the features of this plan having a bearing on additional crossings of the Bay are:

1. Future industrial areas.

At the present time there are limited areas for industrial development in Alameda, Albany, Berkeley, Emeryville, and Oakland. Further to the south, considerable areas at reasonable prices are available in East Oakland, San Leandro, and in Washington Township. Other areas will become available along the entire waterfront from tideland reclamation. Generally speaking, the cost of tideland reclamation is comparatively high, $1.00 per square foot, as against an ample supply of land suited for general industrial use in a range of from 15 cents to $1.00 per square foot. Therefore, it may be anticipated that the development by reclamation will be confined largely to harbor developments and to those industries requiring frontage on deep water.

2. Transportation.

The main transportation arteries are generally located on the plain between the foothills and the shores of the Bay.

It is probable that the Santa Fe will be forced to relocate its line between Richmond and Emeryville on property it has purchased west of the East Shore Highway. Aside from this, no material change in the location of the three main railroads is probable. Spur tracks will be extended as the necessity therefor arises.

In general, the highways also parallel the shore of the Bay. The East Shore Highway and San Pablo Avenue are the principal routes to the Sacramento Valley. To the east, the principal route is through the Broadway Tunnel to Walnut Creek, the industrial area of Pittsburg and Stockton. To the south, MacArthur Boulevard and East 14th Street lead to Hayward, where they divide into routes leading eastward through Dublin Canyon and Altamont Pass to the Central Valley and continuing southward parallel to the shore of the Bay to San Jose and points south along the coast route to Los Angeles. To the west, the Bay Bridge forms the principal connection with San Francisco although from the southern part of the county alternate routes are available via the Dumbarton and San Mateo Bridges.

The most important trunk highways now proposed are the Northern and Southern branches of the East Shore Highway (freeway) parallel to the bay shore. The Northern branch, which constitutes the northern approach to the present Bridge, collects and distributes Bridge traffic for all of the

area north of the Distribution Structure, including Berkeley, Richmond, and points more distant. It also serves the industries of the same territory including those directly tributary to the Contra Costa Industrial Highway between Richmond and Pittsburg. The Southern branch, when constructed, will serve the southern area of Oakland, all of Alameda and the southeastern part of Alameda County. Plans call for converting existing sections of both branches into freeways and, of course, constructing all new sections as freeways. The first important contract on the southerly branch, an overpass of the two railroads at the Foot of 5th Avenue in Oakland, has just been awarded.

Within the area, there are several acute problems of distribution, among which are:

(a) Connections to Alameda. Alameda's insular location, together with its recent rapid development, including the U. S. Naval Air Station, renders additional vehicular connections essential. At the east end of the island, the bridge to Bay Farm Island is old and entirely inadequate for modern traffic. The reconstruction of the Fruitvale Avenue Bridge by the U. S. Government, appears assured at an early date. The Park Street and High Street Bridges are comparatively new structures and will meet all demands in this location for several years. Their average daily traffic amounts to 15,000 and 9,500 vehicles, respectively.

The Posey Tube joining Harrison Street, Oakland, with Webster Street, Alameda, has a single lane in each direction. Completed in 1927, it carries the heaviest traffic of any two-lane highway (insofar as records are available) in the world. Its average daily traffic in October, 1945, was 29,590 vehicles, with a maximum of 32,090. This latter figure (16,000 per vehicular lane) may be compared to a maximum of 80,000 (9,000 per vehicular lane) on the Bay Bridge. This large traffic results in part from the discontinuation of, first, the commuter ferries and, later, the Southern Pacific Bridge trains to San Francisco. As a result of the congestion in the Tube, the commuter service by bus is very slow. The average time, in peak hours, from San Francisco is more than it was by the former rail-ferry service.

At the north end of the Tube, traffic encounters the heavily congested downtown Oakland traffic. Transportation between Alameda and San Francisco must be improved by a direct connection to the present Bridge and to the proposed crossing.

(b) Oakland. In Oakland the most pressing need is the construction of the Southern branch of the East Shore Highway described above.

The second most important need is the reconstruction of MacArthur Boulevard, which carries traffic from the central approach of the Bay Bridge through an intensely developed residential area and connects with the Dublin Canyon-Livermore Canyon route to the San Joaquin Valley. Heavy grades, unsatisfactory alignment a nd insufficient width make the present street inadequate for the heavy and rapidly increasing traffic. Freeway construction along this route will be required in the near future.

Another through East-West route is Mountain Boulevard, which is an interceptor along the boundary between the foothill and mountainous zones. It would constitute a direct route from the vicinity of San Leandro to Berkeley,

would serve a rapidly growing residential area, and would relieve MacArthur Boulevard.

Lake Merritt at the east side of the Oakland business district, forces an unusual volume of traffic on the two streets, 12th Street and Grand Avenue, at the southern and northern end of the Lake. Construction is about to start for a distribution structure to increase the capacity of the 12th Street Dam. Also, for the improvement of 26-27th Streets from Grand Avenue to the western waterfront.

(c) Berkeley. The State Highway Department plans to improve the Ashby Avenue route between the East Shore Highway and the route to Mountain Boulevard and to the Broadway Tunnel. This will relieve, to some extent, the traffic on the central approach to the Bay Bridge and on Broadway north of MacArthur Boulevard.

East Bay Municipal Utility District

Description of District

The East Bay Municipal Utility District is a political subdivision of the State, organized in 1923 under the Municipal Utility District Act. It comprises the nine cities of Alameda, Albany, Berkeley, El Cerrito, Emeryville, Oakland, Piedmont, Richmond and San Leandro, together with a large area of surrounding unincorporated territory.

The District was organized primarily for the development and distribution of a water supply for the entire East Bay area. The major portion of this supply is obtained from Pardee Reservoir on the Mokelumne River, located about 40 miles northeast of Stockton. Water is transported from that reservoir to the District through an acqueduct 94 miles in length, and after reaching the District the water may be delivered direct after filtration or may be discharged into the various terminal reservoirs for use as required. Water is also collected in the four terminal reservoirs, supplementing the supply from Pardee Reservoir. In the fiscal year 1940-41, the average consumption of water in the district was 46 million gallons daily. In the fiscal year 1945-46, the consumption increased to 106 million gallons daily.

It is now planned to construct a second acqueduct line to bring additional water from Pardee Reservoir to take care of the contemplated growth of the District. The present acqueduct line capacity is 95 million gallons daily. Installation of the second line will increase the capacity 50 million gallons daily with gravity flow. After the installation of two booster pumping plants along the line, this increase will be raised to 119 million gallons daily. Added to the present supply and with the two acqueduct lines in full service, the combined ultimate capacity will be 214 million gallons a day.

At the present time water is furnished to an estimated population of 926,000, including those located in Army and Navy installations now served by the District in this area.

Special District No. 1

In 1944 Special District No. 1 of the East Bay Municipal Utility District

was formed by vote of the electors. The Special District comprises the cities of Alameda, Albany, Berkeley, Emeryville, Oakland and Piedmont, and its function is to construct and operate a sewage disposal system for these cities. Preliminary plans and cost estimates have been made for the disposal system comprising intercepting sewers, pumping plants, treatment facilities and outfall sewers. The cost of the construction involved is expected to be over 22 million dollars. A bond issue for raising the required funds will be presented to the electorate in November of this year.

Military Establishments. Alameda County considers the fact that the Army and Navy chose that area for so many military establishments during the war is additional evidence of the advantages of the area for industry. The permanent establishments are (Plate II):

Oakland Port of Embarkation
Camp John T. Knight, Oakland
U. S. Naval Supply Depot, Oakland
U. S. Naval Auxiliary Base, Oakland
U. S. Naval Air Station, Alameda
U. S. Naval Air Transport Service, Alameda
U. S. Coast Guard Base, Alameda
U. S. Maritime Service Officers' School, Alameda
Army Intransit Depot, Alameda
Naval Air Station, Livermore
Western Regional Research Laboratory, Albany
800th Army Air Forces, Specialized Depot, Oakland

In addition there are the two large Oak Knoll and San Leandro naval hospitals, both in Oakland. Camp Parks and Camp Shoemaker at Pleasanton were among the largest naval training centers in the country.

In addition to these purely military establishments, most of the facilities of the Port of Oakland, as well as privately operated port facilities, and the Alameda County industrial establishments joined in the war effort.

IV HARBOR FACILITIES

Unrestricted access to the navigable waters of San Francisco Bay is one of the principal assets of Alameda County. This matter is of such paramount interest in the consideration of additional Bay crossings as to warrant separate treatment as part of the Master Plan for Alameda County.

The existing harbor facilities in the area are shown by Plate III. They consist of those owned by governmental agencies, principally the Army and Navy, those owned and operated by the Port of Oakland, and those owned and operated by private interests.

Oakland Harbor

The development of Oakland harbor, strategically situated on the mainland shore of San Francisco Bay, with direct connections with three transcontinental railroads and the major State highways, began in the early

INDEX TO PORT FACILITIES

"PROFILE AND USE BY PIER OR WHARF"
"PROPERTY OF CITY OF OAKLAND"

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PIERS

- 19 Bendix Corporation, Marine Yard
- 20 Bendix Corporation, Oakland Yard
- 21 Bethlehem Pacific Coast Steel
- *22 Isaac Hilton & Sons, Boat Yard
- *29 Pacific Company
- 11 East Bay Shipbuilding and Repair Company
- 10 General Engineering and Dry Dock Company, Alameda Yard
- *18 General Engineering and Dry Dock Company, Yard No. 1
- 15 General Engineering and Dry Dock Company, Yard No. 3
- *12 Graham Ship Repair Company, Main Yard
- 13 Graham Ship Repair Company
- *32 Healy-Tibbitts Wharf, 5th Avenue Yard
- 31 Harbor Electric Repair Corporation, Howard Yard
- 30 Moore Dry Dock Company, Main Yard
- *35 Moore Dry Dock Company, East Yard
- 36 Pacific Coast Engineering Company
- *37 Pacific Dry Dock and Repair Company
- *32 Parker Diesel Engineering Company
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PIERS

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- * 1 3rd Street Slip at Outer Harbor Terminal
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PIERS

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- *10 Broadway Navy and Shipyard Ferry Landing
- * 9 Fifth Street Ferry Landing
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- 5 Oakland Naval Supply Depot
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- *15 Amelco Building Company Plant
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- 23 Benjamin Franklin Wharf, Port of Oakland
- *27 Fallon Street Industrial Area, Port of Oakland
- *16 Fisherman's Wharf
- 70 Hogan Lumber Company Wharf
- 39 McDonough Steel Company
- *20 Golden Gate Yacht Harbor
- 52 Santa Cruz Portland Cement Company
- 51 Santa Fe Railway Company Wharf
- * 6 Southern Pacific Company Oakland Pier
- * 4 Western Pacific Railroad Company Pier

AIRPORTS

- *42 Oakland Municipal Airport
- **43 U. S. Navy Oakland Auxiliary Air Station
- 61 U. S. Navy Alameda Naval Air Station

ALAMEDA COUNTY COMMITTEE
FOR THE
SECOND BAY CROSSING

OAKLAND HARBOR

WOODRUFF & SAMPSON
ENGINEERS

days of Oakland with the improvement of the estuary in 1855. The Federal Government early recognized the importance of Oakland as a potential deep water port and appropriated funds in 1874 to dredge a deep water channel to serve the city. Through the years the Federal Government has continuously aided in providing deep water channels to Oakland, with expenditures of more than $8,000,000, with large amounts also provided for the same purposes by local public and private agencies. A bond issue in the amount of $2,503,000 was voted by the people of Oakland in 1910, on which channel dredging was included.

In 1925, after consultation with Federal and State authorities, Oakland decided that the harbor's unexcelled facilities for a deep water port should be further improved and expanded, and retained a board of consulting engineers for a study of the entire harbor area. Upon their recommendations, an additional bond issue of $9,960,000 was voted, and the Oakland Board of Port Commissioners was organized on February 12, 1927, to carry out such recommendations and to administer the resulting harbor facilities for the city. This board carries on its operations under the title "Port of Oakland."

In the twenty years since the formation of the Board, Oakland harbor has rapidly grown from a purely local port with practically no modern facilities to a major port of the Pacific which handled a very large share of the supplies and men for the Pacific phases of World War II.

In each of the years 1944 and 1945, Oakland harbor handled 7,500,000 tons of waterborne tonnage, approximately the same as did the Port of San Francisco. It is estimated that a large portion of the latter's tonnage either emanated from or passed through Oakland harbor.

Since the organization of the Board of Port Commissioners, Oakland has spent approximately $15,000,000 in the improvement of the harbor and the construction of terminal facilities. Private interests also spent $10,000,000 for similar purposes. The Board has expended $4,000,000 on the Oakland Municipal Airport, which, under the Master Plan drawn up by the Board for peacetime expansion, will become an integral part of the harbor, and the Federal Government contributed an additional $7,000,000 for the field, making a grand total of $11,000,000 for the airport alone. The total expenditure, therefore, for Oakland harbor, regardless of other large sums spent for private and Governmental terminal facilities throughout the area served by the harbor, is approximately $64,000,000, Alameda having spent $20,000,000 for the same period of time.

Before and during the war large expenditures were made by the armed services and the private and public interests to make the harbor one of the greatest shipping and transportation centers in the Nation. The Navy constructed the $100,000,000 Oakland Naval Supply Depot on land in the Middle Harbor presented by the City, and at the same time built the $75,000,000 Naval Air Station in Alameda. The Army likewise constructed the Oakland Army Base in the Outer Harbor Area, which is the actual base of the San Francisco Port of Embarkation other than the administrative offices at Fort Mason, at an estimated cost of $50,000,000, and the $15,000,000 Air Force Intransit Depot on the Alameda side of the Oakland estuary. At least $20,000,000 was also invested in shipyards and other

waterfront facilities allied to the war effort, while other expenditures to increase the efficiency and service of the harbor by both private and public interests were correspondingly large.

As a result of all this development, Oakland harbor has grown in twenty years from a collection of poorly planned, obsolete and dilapidated installations to the outstanding civil and military maritime base on the Pacific Coast, a valuable and irreplaceable asset both to the people of California and to the Nation, a peacetime center of trade, a vital source of supply in war, and, in any case, an investment of considerably more than $300,000,000.

Oakland harbor, as defined by the U. S. Engineers, comprises the waterfronts of the cities of Oakland and Alameda. The City of Oakland portion of Oakland harbor comprises some nineteen miles of waterfront, two-thirds of which is owned by the municipality, and which is divided into the North Harbor, the Outer Harbor, the Middle Harbor, the Inner Harbor, and San Leandro Bay. In addition, the City of Alameda has seven miles of waterfront suitable for development located along the Inner Harbor. As yet the North Harbor, north of the San Francisco-Oakland Bay Bridge approach, has not been developed, the Army is still using the major portion of the Outer Harbor, and the Naval Supply Depot occupies the Middle Harbor.

Inner Harbor:

The Inner Harbor is an estuary and tidal canal nine miles in length, approximately five miles of which is 800 to 1,000 feet wide, along which the Port and private interests have many valuable and irreplaceable facilities, including the shipyards of the Moore Drydock Company, the Army's Intransit Depot, shipping facilities of Alameda, the Bethlehem Shipyards, Howard Terminals, Grove Street and Ninth Avenue Terminals of the Port of Oakland, the Port's Inland Waterways Terminal, the Hurley Marine Ship Repair Yards, the Graham Ship Repair Yards, the General Engineering and Drydock Company's Shipyards, United Engineering Co. Shipyards, Encinal Terminals, the Coast Guard's large Government Island base and others. Oakland Inner Harbor provides a waterway along which vessels can move about with freedom as there are no obstructions. At the upper, or eastern end, is an artificial tidal canal connecting the estuary with a natural basin, known as San Leandro Bay, on the shore of which is located Oakland Municipal Airport, which will form the nucleus of the future harbor installations of this area.

Outer Harbor:

During the war the Army and Navy added materially to the physical facilities of Oakland harbor. In the Outer Harbor Area alone were added 5,820 lineal feet of piers and wharves, sufficient for the berthing of ten large ships, 2,500,000 square feet of warehouses and transit shed space, and 37 miles of railroad tracks for car storage yards and service tracks to the piers and wharves. The Oakland Naval Supply Depot, which covers an area of more than 500 acres, incorporates fourteen berths for large vessels; 6,500,000 square feet of storage space for warehouses and transit

TABLE III

OAKLAND HARBOR TRAFFIC

1936 - 1945 inclusive.

Year	Annual Tonnage in Short Tons	Vessels In and Out
1936	3,203,597	32,472
1937	3,442,522	29,574
1938	2,832,406	24,694
1939	3,133,138	30,174
1940	3,010,135	30,644
1941	3,164,236	28,055
1942	5,482,587	24,520
1943	6,639,693	23,799
1944	7,419,525	32,161
1945	7,747,481	

A graphic view of Oakland Municipal Airport showing all facilities, including the four runways designed for the heaviest planes now in commercial operation—the dual east-west runways (27L, 6200 feet long, and 27R, 5200 feet long); the north-south runway (15-33, 5500 feet long), and the northeast-southwest runway (24-6, 3800 feet long). Railway, waterway, and highway systems directly serve the Airport

Oakland Municipal Airport, constructed at a cost of $13,000,000, showing its strategic location in the center of the San Francisco Bay region; its proposed future expansion, and its relationship to the proposed harbor facilities projected for San Leandro Bay

Oakland Airport:

Oakland Municipal Airport property has a total area of 2400 acres, which will be fully developed under the Board's Master Plan for the future. 1700 acres will be utilized for airport operations and 700 acres are set aside as the airport industrial area.

Adjacent to the Airport is the San Leandro Bay harbor area where the Port has some 643 acres of industrial property which will be developed under the Port's Master Plan for San Leandro Bay. There are additional areas on San Leandro Bay which will be added as development needs require.

These industrial areas are now served by water, rail and highway outlets making them ideal sites for aircraft manufacturers and allied aviation industries and for harbor industrial purposes.

The construction of the Airport was started early in 1927. It was formally dedicated September 17, 1927, after having served as the starting point for the pioneer Maitland-Hegenberger, Dole, and Kingsford-Smith trans-Pacific flights. It fronts on San Francisco Bay and its development contemplates both land and water facilities. Because of its central location in regard to the San Francisco Bay Area generally, and its unparalleled opportunities for expansion, the Airport may be regarded as the ideal base for all future transoceanic air freight and passenger traffic. Demand for accommodation has been so great since the war, when it served as the major aviation supply base of the Northern California area, that the Board of Port Commissioners has on file numerous applications from foreign and domestic air lines and allied industries seeking hangar space there as soon as it is available.

During the war the Army occupied and used the airport facilities from Pearl Harbor Day not alone as a key hop-off point for the Pacific battlefronts, but also as a defense operations base for the protection of our Pacific shoreline and for the processing and shipping of fighter planes to the numerous fighting fronts across the Pacific. Many thousands of these fighter planes were flown from the airplane factories to Oakland Airport and there processed for shipment by mass production procedure.

Following their processing, these planes were loaded aboard barges moored at the airport dock, which were towed from the airport, traversing the airport channel and tidal canal to waiting ships in Oakland Harbor and other Bay ports, and there the fighter planes were loaded aboard for shipment across the Pacific. Bombers and other large Army aircraft were flown from the airport to their bases of operation in the Pacific.

The United States Navy selected the Oakland Airport as a Naval Air Transport base for its trans-Pacific and transcontinental operations and established, at a cost of about $5,000,000 a well equipped base, having three large hangars, storage warehouses, air cargo warehouses and supporting shops, barracks and miscellaneous facility buildings. With the completion of its mission, the Navy has announced that this base will be declared surplus. The Board of Port Commissioners will endeavor to acquire

the hangars and such other structures of the Navy base as are suitable for civilian aviation activities.

To provide adequate operational facilities for military needs during the war, the Oakland Municipal Airport operational area was greatly expanded. At an expenditure of about $2,000,000 the airport field was widened about 1,000 feet, a heavy duty runway was constructed with a length of 6,200 feet, parallel to the existing 5,200-foot East-West runway, thus providing the airport with dual runways, an advanced traffic speeding feature afforded at very few air terminals in the Nation. Adequate taxiways were also constructed to serve both runways.

Operations of Oakland Municipal Airport are shown on Table IV.

TABLE IV

OAKLAND MUNICIPAL AIRPORT

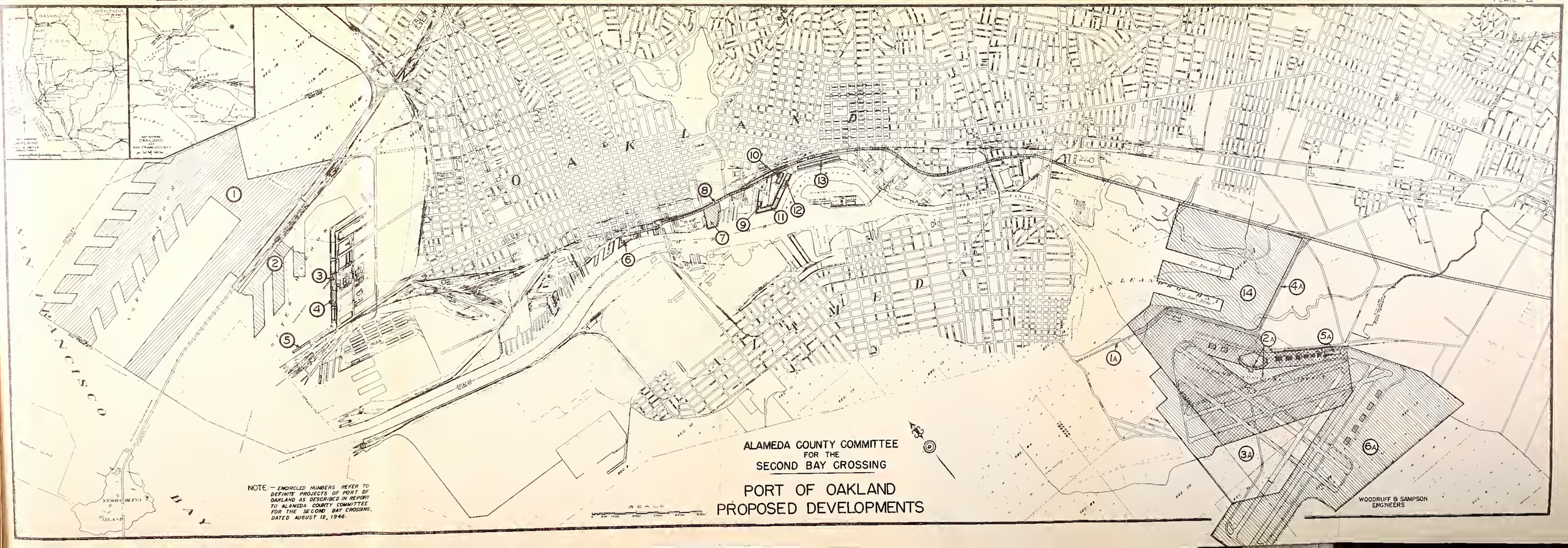
RECORD OF OPERATIONS

Calendar Years

	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945
LANDINGS:										
Other than student	19,112	23,453	16,815	18,242	24,804	32,766	26,615	36,433	33,584	43,575
Student	84,524	118,670	114,265	108,951	207,214	217,816				
Total	103,636	142,123	131,080	127,193	232,018	255,582	26,615	36,433	33,584	43,575
TRANSPORT PLANES										
Inbound	5,930	4,772	4,457	5,507	7,442	8,515	7,455	6,528	7,542	9,241
Outbound	5,963	4,801	4,471	5,532	7,470	8,581	7,457	6,530	7,542	9,241
1. TRANSIENT PLANES:										
Inbound	1,750	2,688	3,009	3,742	4,841	4,954	6,849	9,052	12,261	16,031
Outbound	1,750	2,688	3,009	3,714	4,818	4,926	6,924	9,111	12,088	16,011
PASSENGERS (Other than Students):										
Transport Inbound - All	17,473	17,148	22,487	34,558	45,013	56,177	90,933	99,628	108,577	136,760
" " - Oakland			12,591	21,189	25,169	29,879	20,678	15,952	17,057	20,192
Transport Outbound - All	18,474	18,578	22,412	34,212	46,226	58,586	92,727	104,958	115,155	145,453
" " - Oakland			12,527	20,714	26,265	34,342	22,420	21,273	23,619	28,895
2. Transient Inbound	2,518	4,189	5,070	5,694	7,335	7,483	10,339	13,119	18,374	
2. " Outbound	2,495	4,157	5,047	5,669	7,333	7,465	10,435	12,928	18,119	
Taxi	11,497	19,902	18,647	19,000	20,110	26,723	2,951			
Total	52,457	63,974	73,663	99,133	126,017	156,434	207,385	230,633	260,225	282,213
3. AVERAGE NO. OF STUDENTS ENROLLED PER MONTH:	385	422	637	760	1,125	1,270	1,118	739	244	229
STAMP SALES:	$7088.81	$6098.77	$5754.42	$6356.70	$7173.85	$9589.80	$16,807.73	$15,494.91	$13,113.55	$10,059.88
MONEY ORDERS:	704	988	1,125	1,234	1,294	2,653	6,135	6,452	4,167	2,880
REGISTERED LETTERS:	680	749	778	850	1,006	1,381	1,650	1,890	1,892	823
POUNDS OF AIR EXPRESS:	39,000	45,400	55,800	57,300	63,300	95,806	594,906*	507,971*	591,555	676,607
POUNDS OF AIR MAIL:									1,531,499	1,576,544

1. Includes military.
2. Eliminated for year 1945, since only an estimate.
3. Average for 1st seven months, 1945. All student contracts cancelled after August, 1945.

* Estimated amount based on records furnished for part of year;


OAKLAND
SAN FRANCISCO BAY
ALAMEDA COUNTY COMMITTEE
FOR THE
SECOND BAY CROSSING
PORT OF OAKLAND
PROPOSED DEVELOPMENTS
NOTE:— ENCIRCLED NUMBERS REFER TO DEFINITE PROJECTS OF PORT OF OAKLAND AS DESCRIBED IN REPORT TO ALAMEDA COUNTY COMMITTEE FOR THE SECOND BAY CROSSING, DATED AUGUST 12, 1946.
SCALE
WOODRUFF & SAMPSON ENGINEERS

Oakland's Outer Harbor area, showing the Port of Oakland's Outer Harbor Terminal, and the $50,000,000 Oakland Army Base, supply center for the Pacific war, which will continue its vital functions during peacetime

Oakland Naval Supply Depot in Oakland Middle Harbor with the Southern Pacific pier on the left and the Western Pacific pier on the right

Hurley Marine Works in the Oakland Inner Harbor showing ships undergoing repair in the yard

The Grove Street Pier on the Inner Harbor at the foot of Grove Street in Oakland showing ships at berth

Oakland's extremely valuable Outer Harbor and the Middle Harbor areas, the Southern Pacific pier and slips in the foreground

The Port of Oakland's Ninth Avenue Terminal on the Inner Harbor with Lake Merritt and the Oakland business district in the background

Westerly section of Oakland's Inner Harbor with the Moore Dry Dock Company, Grove Street Terminal, Howard Terminal, and other shipping installations, and Lake Merritt and the Oakland business district in the background

Easterly section of Oakland's Inner Harbor showing the Coast Guard's Government Island base left center in the middle of the waterway, the Ninth Avenue Terminal of the Port of Oakland bottom left, Encinal Terminals right center, and the tidal canal leading to San Leandro Bay

Oakland Middle Harbor area, presenting a graphic picture of the Southern Pacific pier and Albers Milling Company's modern cereal plant in the foreground and the $100,000,000 Oakland Naval Supply Depot

Postwar Program

The Board of Harbor Commissioners has plans to expand the existing facilities to meet the demands which will accompany the assured industrial development of the area. See Plate IV.

In view of certain proposals for additional Bay crossings, special attention should be given to the proposed development of San Leandro Bay. This area is especially suitable for handling the products from the southern part of the County and from the Central Valley of California. This project will provide truck-to-boat facilities which will avoid trucking through the congested streets of Oakland.

Albany and Berkeley Waterfronts

To date there has been no development of the waterfront facing Albany and Berkeley west of the East Shore Highway between Oakland and Richmond. The first development will probably be the above-mentioned relocation of the Santa Fe line between Richmond and Emeryville which will generally parallel the East Shore Highway.

Those who have studied the potential air traffic believe that in a comparatively short time a major airport will be required in addition to Oakland Airport and San Francisco Municipal Airport (Mills Field). The logical location for such an airport appears to be along the Berkeley waterfront. This matter is now before the U. S. Army Engineers through a request (19) by the City of Berkeley for a comprehensive investigation.

This Airport and a probable development (worked out to match the similar plans of the Port of Oakland) are indicated on Plate II.

It may be emphasized that the past development of the harbor facilities has been to meet the economic necessities as they arose. The same is true of the plan for the future development. The plans are also coordinated with those for the comprehensive development of the entire area.

V A SECOND BAY CROSSING

History -- Existing Bridge

Since its opening to vehicular traffic on November 12, 1936, vehicular traffic across the Bay Bridge has exceeded all estimates made prior to its construction. The rail facilities of the bridge, opened for traffic on January 15, 1939, have also carried an immense traffic, but have never been used to half their capacity. To a very considerable extent, the Bay Bridge made possible the remarkable contribution of the Bay Area to the war effort.

The vehicular capacity of the Bridge is rapidly being approached. With the development of the Bay Area that appears assured, there is little doubt of its comfortable capacity being reached before a new one can possibly be completed.

The success of the present bridge results in no small measure from the manner in which the entire project was managed by the California Toll Bridge Authority and in particular by the Chief Engineer of the Authority, Charles H. Purcell, now Director of Public Works of the State of California. This procedure has such a bearing on the present proposal as to warrant a short resume thereof.

Prior to the establishment of the California Toll Bridge Authority in 1929 (Chapter 763, Statutes of 1929 with subsequent amendments), the Laws of California provided that permits for toll bridges would be under the jurisdiction of the county on the left bank, in this case San Francisco. While there were previous proposals for a bridge across the Bay, it was not until about 1920 that the development of the automobile and the resulting traffic made such a bridge economically possible. Many applications were made by private promoters for a franchise for the Bridge until by 1938 there were a total of 38 such applications (4). For advice in the matter, the Board of Supervisors of San Francisco selected a Board of Consulting Engineers, whose report (1) may be considered the first real attempt at a solution. However, mainly because of a lack of information concerning foundation conditions, this report did little towards a solution of the problem.

For this reason the first constructive effort toward the Bridge was the work of the Hoover-Young Commission. This Commission convened on October 7, 1929 and presented its report on August 6, 1930. The engineering studies were made by the State Division of Highways. Too much credit cannot be given to the work of this Commission. It reconciled certain differences that had theretofore prevailed between the military authorities and the proponents of a bridge. It made a fair compromise of the requirements for national defense, navigation and the needs for a bridge. The Report (2) of this Commission was the basis for the location and design of the Bay Bridge. Insofar as any official statements have since been made, the conclusions of this Commission represent the present position of the Army and Navy.

In 1931 the State legislature made appropriations for additional foundation investigations and the design of the bridge. Applications for financing the bridge were made to the Reconstruction Finance Corporation in 1932. After several months of negotiation and necessary work to meet their requirements, including the preparation of contract designs and specifications and the taking of bids on the major contracts, the Reconstruction Finance Corporation, on April 27, 1933, agreed to finance the vehicular facilities. There were considerable delays in reaching agreements with the Southern Pacific and Key System covering the railway facilities. Consequently the financing of the railway facilities was not consummated until March, 1936.

Second Crossing

The results have been so satisfactory as to establish a precedent for a second crossing. The Joint Army-Navy Board corresponds to the Hoover-Young Commission. With the experience of the late world war the members of this board are in the best possible position to evaluate the respective requirements of national defense, navigation and motor vehicles.

As seen by an outsider, the California Toll Bridge Authority is in the following position:

1. It has achieved an enviable reputation in the design, construction and operation of the present bridge;

2. In case a second crossing is to be financed by tolls, by California law the Authority has sole jurisdiction. From a practical standpoint, there appears no other means of financing.

3. The financing of a second crossing by the Authority presents several difficulties. As of February 28, 1946, bonds were outstanding in the amount of $49,776,000. The Authority is obliged to repay the State Highway Department

6,600,000	
$56,376,000	
5,082,000	- Revenue Fund Reserve (approximately)
$51,294,000	- Net obligation.

For the fiscal year ending February 28, 1946, the excess of revenues over charges was $6,787,457. Among these charges was one of $1,227,052 for interest. This latter item will decrease as the bonds are retired. It may be anticipated that over $7,000,000 annually will be available for retirement of outstanding obligations with the result that, if no new crossing is started in the meantime, all obligations of the bridge will be retired and the bridge become toll free about January 1, 1953.

In view of increased costs and of the fact that the present bridge was constructed in the most economical location, it may be assumed that a bridge with ten vehicular lanes will cost, without approaches, roughly $100,000,000. If the project were authorized at the coming session of the legislature, it could be completed in 1952. In order to keep the Reserve Fund intact, it is probable that the refinancing of the present obligations and the construction of the additional facility would be in the order of $110,000,000. With the revenues that may reasonably be anticipated, the financing should not be too difficult. It is however apparent that the financing should be kept to a minimum consistent with providing adequate facilities, and that no facilities other than those for motor vehicles should be provided unless separate means of financing them is arranged. Another consideration is the difficulty of securing adequate insurance against physical damage and to protect earnings on a large investment.

However, it is necessary to consider the approaches and means of distributing traffic on both sides of the Bay. At present, on both sides of the Bay, the streets are congested and there is a serious lack of parking facilities.

In this respect and as above outlined in more detail, the City of Alameda is especially concerned. The city did not receive the same advantages from the present bridge as did other parts of the area. In fact, the commuter facilities are inferior to the previous ferry service. In any studies of a Bay crossing, the City of Alameda should receive special consideration.

It is therefore essential that any study of an additional crossing consider the location of the approaches and also the means whereby they may be financed. The bridge and approaches should preferably be combined as a unit, and the approaches should be included in any plans for overall financing.

Another consideration is that of operating expenses. The financing of the present bridge provides that all operating expenses shall be paid from State Highway maintenance funds, with the result that for the last fiscal year $753,036 was taken for such purpose. With a second crossing, this amount would soon reach $1,500,000 annually. This money is required for highway maintenance and in the new financing it would therefor be desirable that the operating expenses be paid from tolls.

The above should not be construed as criticism of the Toll Bridge Authority in regard to the present bridge. Such requirement was inserted in the original agreement by the Reconstruction Finance Corporation, whose estimates of traffic and revenue were below those submitted by the Toll Bridge Authority. In retrospect, this provision has been in the public interest in that it made possible the early decreases in the toll structure. This reduction, in turn, contributed largely to the traffic. The present tolls present only a small barrier to economical transportation.

General Economics. In the location, design, construction and operation of the present bridge, the Toll Bridge Authority established another precedent which Alameda County trusts will be followed in additional crossings; the entire project was based on sound economics.

Its detail location was selected to utilize property that was not highly developed. This was done in order that the cost of the property might be the least possible; also that the reduction in tax rolls might be as small as possible. Throughout its design, every effort was made to keep the cost at the lowest possible amount consistent with safety and the provision of adequate facilities. In fact, had the amount of traffic been foreseen and had it been possible to convince the Reconstruction Finance Corporation of the probability, the width of the traffic lanes would have been increased. Since the opening of the bridge to traffic in 1936, the operation and maintenance of the bridge has been conducted efficiently.

Traffic and Revenue

Presumably the California Toll Bridge Authority will present its estimates of traffic and revenue for a second crossing at the hearing before the Joint Army-Navy Board. However, to furnish an independent estimate, Table V has been prepared to furnish our opinion in this matter.

This estimate is based on the assumption that motor vehicle registration in the nine Bay Counties is the best index of bridge traffic. This is slightly on the low side, since past trends have been for the mileage per car to increase.

In this table, the estimate of future population of the nine Bay counties has been taken from Table I as modified by the explanation thereof. In column (3) the recorded automobile registration, including the year 1945, has been listed and the persons per car calculated (column 4). This trend has been plotted on Figure I and extended to 1970. Applying this trend to the population completes the estimate of motor vehicles. It may be noted that the estimates for 1960 and 1970 are, respectively, 2.04 and 2.66 those of the 1940 registration. This is somewhat below the average predictions of many who have had occasion to make similar estimates.

Column (5) shows the recorded number of vehicles from 1920 to 1945, with 1946 estimated on the basis of traffic for the first six months. Dividing this by the number of registered motor vehicles gives column (6), or the average number of Bay crossings for the average registered vehicle. The trend of this line, Figure I, has generally been sharply upward since the completion of the Bay Bridge, except during the period of gas rationing. This upward trend may continue. However we have leveled it off at 333 cars per year or approximately the present rate. The total number of passengers should be considered approximate only, since no count of passengers is made on the bridge except in buses and on trains.

These estimates are based on the following assumptions:

a. Ample bridge capacity. If the bridge were not congested, the number of vehicles now crossing the bridge would be increased.
b. Adequate approaches and street capacity in the cities on both sides of the Bay.
c. An average level of business activity.
d. The retention of the present toll structure. If and when the crossings become free, a considerable increase in traffic will result.

From the above, it seems probable that the capacity of the crossings, assuming equal division of traffic, will be reached within twenty years after the completion of the second crossing.

Type of Crossing - Navigation Requirements

Alameda County has no preconceived ideas as to the type (e.g., bridge or tunnel) of the new crossing. The Committee believes that the first consideration in this regard should be that of navigation, and that this consideration rules out a low level causeway for any considerable portion of the crossing. A review of past history, in this respect, follows.

In 1921, after a public hearing, the United States Army Engineers prescribed the following limitations:

"1. No bridge of any kind will be approved north of Hunter's Point.
2. No low bridge will be approved north of San Mateo.
3. A tunnel would be approved at any location if kept below a depth of 50 ft. and if proper provision were made for taking care of the tidal prism.

4. A combined bridge and tunnel would be approved if the tunnel were kept below a depth of 50 ft. and if a 3,000-ft. open channel were left on the San Francisco side, suitable provision being made for the tidal prism where bridge and tunnel join.

5. Not more than one crossing is to be approved at present north of San Mateo."

It may be noted that paragraph 4 of the above contemplated a bridge for that portion of the crossing other than the tunnel in order that the tidal prism might not be unduly restricted with resulting high velocities.

With the rapid increase in motor vehicle traffic, it became evident to the Hoover-Young Commission that some relaxation of these restrictions were in the public interest. The following resolutions of this Commission are quoted:

"That the bridge between San Francisco and Goat Island shall consist of not more than four main spans, the westerly one of which shall have a horizontal clearance of not less than 1750 feet between fenders.

"That the vertical clearance on the two center spans shall be not less than 214 feet above M.H.H.W. at the center of the spans, and that this height shall be maintained for approximately 500 feet on either side of the center of the span, and that the minimum vertical clearance at the San Francisco pierhead line shall be 180 feet above M.H.H.W.

"That the main channel span in that portion of the bridge between Goat Island and the east shore should have a minimum vertical clearance of 180 feet above M.H.H.W. and a minimum horizontal clearance of 600 feet between fenders. Consideration should be given in the final plans to a minimum clearance of 700 feet between fenders."

These conclusions were followed by the Toll Bridge Authority in their application for War Department approval of plans for the present bridge. The War Department, after public hearings, requested some increase in the above-mentioned clearances, especially those in the East Bay Crossing.

The Bay Bridge has now been in service for ten years. During the war, the Bay has been crowded with shipping. There is no known record of any delay or damage to shipping by reason of the obstruction resulting from either overhead or vertical clearances.

The 1941 Report of the Joint Army and Navy Board (3) proposed one span with 1000 ft. horizontal clearance and with 214 ft. (above M.H.H.W.) vertical clearance. However the plans provided for 14 and 24 - 504 ft. spans on the west and east sides, respectively, of the main channel, which would be available for smaller craft. The plan provided for 28,981 ft. of crossing, unobstructed except for bridge piers, for the tidal prism. In the case of the low level bridge, south of Hunter's Point, the corresponding provision for the tidal prism, including bridge piers, was 34,909 ft. It may be noted that with these great widths, the Joint Board of 1941 examined the effect on the tidal prism.

It is suggested that this latter study and the final approved plans for the present Bay Bridge establish a precedent which protects the interests of national defense, navigation and transportation. North of the Oakland Estuary we believe the clearances should not be less than those of the present bridge. South of the Estuary those proposed by the 1941 Joint Board should allow for adequate present and future shipping needs in San Leandro Bay.

Assuming that the Joint Army-Navy Board concur in this suggestion, the only possible solutions for a crossing north of Hunter's Point are a high level bridge or a subaqueous tunnel extending between bulkhead lines on each side of the Bay.

Either a high level bridge or subaqueous tunnel would provide satisfactory vehicular or rail facilities. The question then becomes one of the economics of a structure that, presumably, must be self-liquidating. As information in this respect, the following tabulations are quoted from the Hoover-Young Report:

Table 39 - Bridge - 10 traffic lanes, total cost $72,000,000, $7,200,000 per lane

Table 42 - Tube - 6 traffic lanes, total cost $96,000,000, $16,000,000 per lane

Table 46 - Bridge - Operating cost $650,000 annually, $65,000 per lane

Table 47 - Tube - Operating cost $2,100,000 annually, $350,000 per lane

The estimates, both of construction and operating costs, for the bridge, have been proved by actual experience to be reasonably accurate. There is no reason to believe that the same is not true of those for the tubes.

Presumably for this reason the Hoover-Young Commission resolved: "It is the sense of this Commission that the proposed tube be eliminated from consideration."

TABLE V

TRAFFIC BETWEEN OAKLAND AND SAN FRANCISCO
RECORDED AND ESTIMATED

Year	Nine Bay Counties			Vehicles Crossing Bay	Crossings per M.V.	Passengers Crossing Bay			Trips per Capita
	Pop.	M.V.R.	P/C			Vehicular	Rail*	Total	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1920	1,184	146	8.08	773	53	2,610	37,925	40.535	34.2
1921	1,223	169	7.23	829	49	2,818	37,053	39,871	32.6
1922	1,262	209	6.05	935	45	2,747	37,130	39,877	31.6
1923	1,302	254	5.13	1,225	48	3,270	38,938	42,208	32.4
1924	1,341	303	4.42	1,343	44	3,464	39,698	43,162	32.1
1925	1,380	339	4.07	1,539	45	3,848	39,671	43,519	31.5
1926	1,420	382	3.71	2,679	70	6,440	37,327	43,767	30.8
1927	1,459	403	3.60	3,482	86	7,896	36,696	44,592	30.6
1928	1,498	430	3.48	4,055	94	9,043	35,592	44,625	29.8
1929	1,538	464	3.32	4,401	95	9,568	34,349	43,917	28.6
1930	1,578	479	3.29	4,544	95	10,013	33,022	43,035	27.3
1931	1,594	484	3.30	4,434	92	9,915	30,519	40,434	25.3
1932	1,610	474	3.39	3,818	81	8,978	27,093	36,071	22.4
1933	1,626	472	3.44	3,433	73	8,456	24,816	33,272	20.5
1934	1,642	479	3.42	3,558	74	8,736	24,981	33,717	20.5
1935	1,657	512	3.23	3,937	77	9,470	26,017	35,487	21.4
1936	1,673	555	3.02	4,417	80	12,168	26,364	38,532	23.0
1937	1,689	589	2.86	9,108	155	22,827	22,574	45,401	26.9
1938	1,705	595	2.87	8,621	145	24,468	20,153	44,621	26.1
1939	1,720	620	2.78	10,963	177	25,112	20,388	45,500	26.5
1940	1,736	658	2.63	15,264	232	30,581	18,424	49,005	28.2
1941	1,902	703	2.70	19,079	272	38,568	14,023	52,591	27.6
1942	1,068	686	3.01	20,571	300	44,907	16,366	61,273	29.6
1943	2,234	700	3.20	19,159	273	41,423	21,464	62,885	28.1
1944	2,400	720	3.33	18,625	258	39,431	24,010	63,441	26.4
1945	2,490	740	3.36	22,128	299	47,271	26,519	73,790	29.6
1946	2,570	760	3.38	25,000	329	53,300	23,700	77,000	29.9
1950	2,350	840	2.80	25,200	300	53,700	20,000	73,700	31.4
1955	2,650	1,020	2.60	30,600	300	65,200	20,000	85,200	32.0
1960	2,900	1,130	2.56	33,900	300	72,200	22,000	94,200	32.5
1965	3,250	1,285	2.53	38,500	300	82,000	25,200	107,200	33.0
1970	3,500	1,400	2.50	42,000	300	89,500	27,700	117,200	33.5

Note: Columns 2,3,5,7,8 and 9, figures in thousands. *Rail passengers to and from Yerba Buena Island not included.

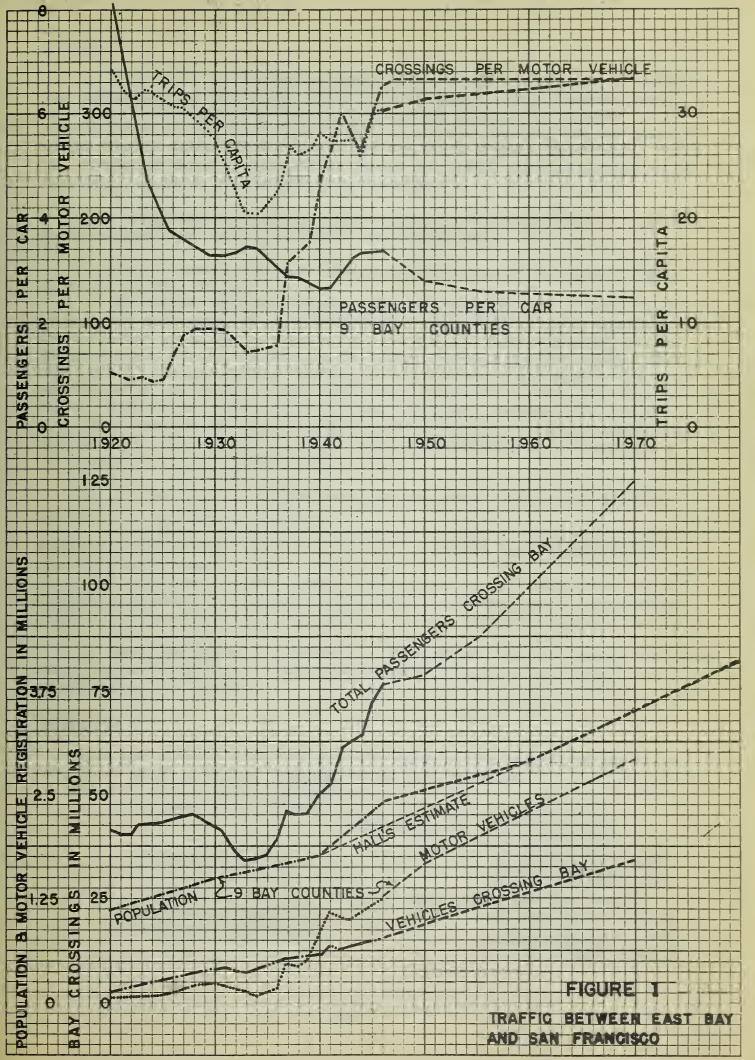


FIGURE 1

TRAFFIC BETWEEN EAST BAY AND SAN FRANCISCO

Location

The California Toll Bridge Authority has a study under way to determine the location of an additional crossing or crossings. We understand that, as a part of this study, additional borings are shortly to be made. A comprehensive traffic survey is being made on both sides of the Bay jointly by the Federal Roads Administration and the State Highway Department. Until the results of these investigations become available, any speculation as to the detail of the location appears presumptuous.

There are, however, general controls that we believe should be applied in determining the general location, among which are:

(a) The new crossing should take approximately half the future traffic from the existing bridge.

The traffic estimates given above indicate that the capacity of two bridges may be reached in about twenty-five years. It is quite possible that the estimates given are as much on the low side as those submitted to the Reconstruction Finance Corporation in 1932. Previous traffic studies show that over 60 per cent of the traffic, on the San Francisco side of the Bay, originates in the comparatively small area bounded by the Bay, the Channel and Van Ness Avenue, the remaining 40 per cent being spread quite uniformly over other areas of the city. Primarily the bridge is a facility connecting the business center of San Francisco with business centers and residences for commuters in the Alameda County cities.

(b) The cost of the bridge should be the lowest consistent with the provision of adequate facilities.

To a very large extent, the costs of the bridge will depend upon foundation conditions, which will not be known until the investigations above are completed.

If the traffic above estimated develops and if maintenance and operating expenses are paid from tolls, it is probable that a third bridge will be required by the time the cost of both crossings can be amortized.

(c) Any crossing will interfere to some extent with the harbor facilities on both side of the Bay. The location should be such as to reduce this interference to a minimum.

Facilities

There are certain facts and controls which have a bearing on the facilities which should be provided in the new crossing.

The cost of the present bridge was:

Vehicular facilities - Bond proceeds	$54,668,809.10	
Highway funds	6,600,000.00	
	$61,268,809.10	- 77%
Railroad facilities	18,315,062.16	- 23%
	$79,583,871.26	-100%

Up to and including June 30, 1946, the bridge revenues have been

Vehicular facilities	$51,765,435.08	- 93.4%
Railroad facilities	3,674,133.55	- 6.6%
	$55,439,568.63	-100.0%

Thus, to a very considerable extent, the motorist has been subsidizing the train passenger. In the interests of community development, provision of the rail facilities on the Bridge was justified. However, adequate rail facilities are now available on the existing Bridge for the commuter, and there appears to be no reason to repeat a similar procedure.

The additional facilities which have been most frequently suggested are provisions to bring the Southern Pacific, Santa Fe and Western Pacific trains from their present terminals on the east shore of San Francisco Bay, to the west side. These terminals are an important part of the industrial development of both Alameda and Contra Costa Counties. The county, however, will subordinate its interests to those of the Area as a whole, provided an adequate showing can be made covering the following:

(a) That such facilities do not involve a location that would increase travel time, mileage and operating costs for the average motor vehicle.
(b) The amortization of the cost of such facilities is not met in any degree by the motor vehicle traffic, nor the period of amortization extended by reason of the additional facilities.
(c) That discussion of such facilities and arrangements therefore do not materially extend the time required to place a new bridge in service.
(d) That navigation requirements, both for the present and future, be protected regardless of what type of crossing is chosen.

Alameda County believes that these questions are of such importance that they should be frankly discussed and settled in order that the construction of a second crossing may proceed at the earliest possible date.

The present situation is as follows:

The Southern Pacific has a water level route from the Oakland Terminal to San Francisco for freight by way of the Dumbarton Bridge. Its facilities are geared to this connection. Presumably the Company would not be interested in any drastic change in this regard. Its passengers to and from the East are loaded and discharged at Berkeley, Sixteenth Street in Oakland, and Oakland Mole. Connections between the first two stations and San Francisco are made by private automobile and taxicab. Ferries operate between Oakland Mole and San Francisco. The use of the automobile results in over a half-hour saving in time. In prewar years, the number of passengers was about 1,500,000 annually, and with postwar air competition it is doubtful if any material increase can be anticipated.

The Santa Fe passenger terminal is located at 40th Street and San Pablo Avenue in Emeryville. San Francisco passengers are carried from this terminal to one at Fourth and Mission Streets, in the heart of San Francisco, by bus across the Bay Bridge, the time between terminals being only twenty minutes. In normal times the number of Santa Fe passengers is about 300,000 annually. Santa Fe freight destined to and from San Francisco is handled by car float between its water terminal in Richmond and Pier 48 in San Francisco.

The Western Pacific Railroad reaches the area through Niles Canyon and turns north to its Oakland terminal. Its passenger trains proceed to Oakland Mole, San Francisco passengers being handled by the Southern Pacific ferries. The number of passengers is about 150,000 annually. Western Pacific freight to and from San Francisco is handled by car float from the Oakland terminal to the Western Pacific Terminal north of Islais Creek.

In San Francisco, distribution of freight to the various industries and the waterfront is by a combination of trackage, partly owned by the railroads but mainly by the Harbor Belt Line Railroad, a facility of the State Harbor Board. These facilities have been considerably expanded during the war. They are geared to the economic life of San Francisco and accommodated the abnormal volume of business during the war efficiently. Their disruption would entail damages running into many millions.

A thorough analysis of the construction costs of moving the terminals of the three railroads into San Francisco, of the effects on the railroad operating costs and all of the economics connected therewith, would involve a study far beyond the scope of this report. However, it is believed possible to prove conclusively by comparisons with other locations, by roughly estimating the expenditures involved, and by showing that the benefits would be comparatively small, that the provision of rail facilities on any crossing of the Bay is so uneconomic that even the expense of the above mentioned analysis is not justified.

Possibly the nearest comparison to the local situation is that of New York City, the principal difference being that the North River is only one mile wide as compared with an average of four miles for San Francisco Bay, with a corresponding difference in the cost of facilities. The comparison becomes even more striking if a map of New York Harbor is turned 180 degrees so that Jersey City, Hoboken and Weehawken correspond to the cities on the east shore. One railroad, the Pennsylvania, has facilities (tubes) for bringing its passengers under the North River. These facilities were completed, in 1910, at a total cost of $160,000,000. At present cost levels, over $500,000,000 would be required for a similar project. This cost includes the connections under the East River to Long Island City and the extensive Sunnyside Yards required for storing and servicing the passenger equipment when not in use. This terminal serves 50,000 passengers daily or approximately 20,000,000 per year. (Note: Figures are approximate only and are subject to further check.)

The other railroads entering the New York Area from the West have never found it economically feasible to construct similar facilities. These roads' approximate number of passengers and methods of reaching Manhattan are shown by the following tabulation:

Carrier	Annual Number* of Passengers	Method of reaching Manhattan
Ontario and Western	(small)	Ferry
West Shore	(small)	Ferry
Erie	25,000,000	Ferry and Tube
D. L. & W.	21,000,000	Ferry and Tube
B. & O.	**	Ferry and Bus
Reading	***	Ferry
C. R. R. of N. J.	14,000,000	Ferry

*From "Applications to the United States War Department for closing certain Drawbridges" - - 1926.

**Number not available - about 100,000 annually.

***Included with C.R.R. of N.J.

Over the years many plans have been considered for direct rail connection to Manhattan for these passengers, but none has been found to be even remotely economical. If a crossing cannot be justified for more than 60,000,000 passengers, it indicates that one across San Francisco Bay for two million passengers is, to say the least, dubious from an economic standpoint.

All freight from these railroads terminating West of the North River destined to New York (as well as most of that destined to the New England States) crosses the river on car floats. Again the railroads have found that any savings that might result from a bridge or tube are insufficient to warrant the large expenditures necessary.

The possibilities of a bridge with rail facilities across San Francisco Bay will be discussed generally. Three possible locations may be considered (Plate I):

1. Parallel to the present bridge
2. Location A-1, a high level crossing north of Hunter's Point (10)
3. Location A-2, a low level crossing south of Hunter's Point (10)

It will be assumed that the eastern terminus for locations 2 and 3 would be at Bay Farm Island.

Third and Townsend Terminal. The present facilities at the Third and Townsend Street Station, not only the terminal itself but the approaches, coach yards, etc. are ample for the traffic from the Peninsula and points south. However any proposal for bringing a large number of additional passengers into San Francisco necessitates the enlargement and, in many cases, the complete rebuilding of many of these facilities. The Los Angeles Union Passenger Terminal occupies 2,000,000 square feet, the Southern Pacific Coach Yard in connection with this terminal 1,372,000 square feet. The acquisition of property in comparable amounts in the business area of San Francisco would involve staggering expenditures.

Location 1

On the east shore of the Bay, location 1 is fairly convenient to all three railroads. Presumably it would necessitate the Western Pacific's obtaining trackage rights for some distance from the Southern Pacific. It would require a considerable rearrangement of the existing facilities and probably the acquisition of considerable property.

On the west side of the Bay, the proposal would involve the acquisition of property in a highly developed area and would involve heavy construction costs for new facilities.

On the bridge itself, the grades would have to be reduced from the 3-1/2 per cent suitable for motor traffic to a maximum of 1-1/2 per cent. This would involve a new location of the Third and Townsend Station or an extensive loop to reach grade.

The writer's opinion of the general order of the costs involved for double track rail facilities is as follows:

Oakland Approaches	$10,000,000
San Francisco Approaches and Terminal	40,000,000
Bridge	30,000,000
Total	$80,000,000

Location 2

The Joint Army-Navy Board, in 1941, estimated the cost of a high level bridge in this location at $53,200,000. The facilities contemplated included:

Four lanes for light vehicles on an upper deck
Two lanes for trucks on a lower deck
Two railroad tracks on a lower deck

This report (3) does not divide the estimate between railroad and vehicular facilities. The estimate that one-third of the total, or $18,000,000 would be chargeable to railway facilities appears fair.

On the Oakland side of the Bay, the Santa Fe has no facilities south of 20th Street, Oakland. To use these facilities they would either have to secure trackage rights from the Southern Pacific and Western Pacific or secure right-of-way and build a new line. Even the Southern Pacific facilities, occupying in part public streets, are not suitable for a heavy volume of traffic. An investment of not less than $10,000,000 on the east side of the Bay would probably be required.

The Southern Pacific passenger facilities have been described above. To provide for the increased volume an expenditure of perhaps $32,000,000 would be required. Therefore for railroad facilities, an investment of approximately $60,000,000 would be required.

The benefits, if any, for passenger traffic may be considered.

The distance from the 16th Street Station, Oakland, via Bay Farm Island and Hunter's Point to Third and Townsend Streets, San Francisco, is 21 miles. Considering that part of this route is within switching limits, other parts in city streets, that the grade over the bridge is 1-1/4%, the scheduled speeds even for streamliners would not be less than forty minutes. The corresponding time by motor car from 16th Street, Oakland, to 3rd and Market Streets, San Francisco, is less than 20 minutes, the present schedule, by ferry, 30 minutes. Therefore, the net result would be that the majority of passengers would use motor transportation with the trains carrying no passengers.

The Southern Pacific has 32 scheduled passenger trains in and out of Oakland per day, the Santa Fe 8 daily. The additional passenger train for these two roads would be 300,000 annually.

The annual charges would be approximately:

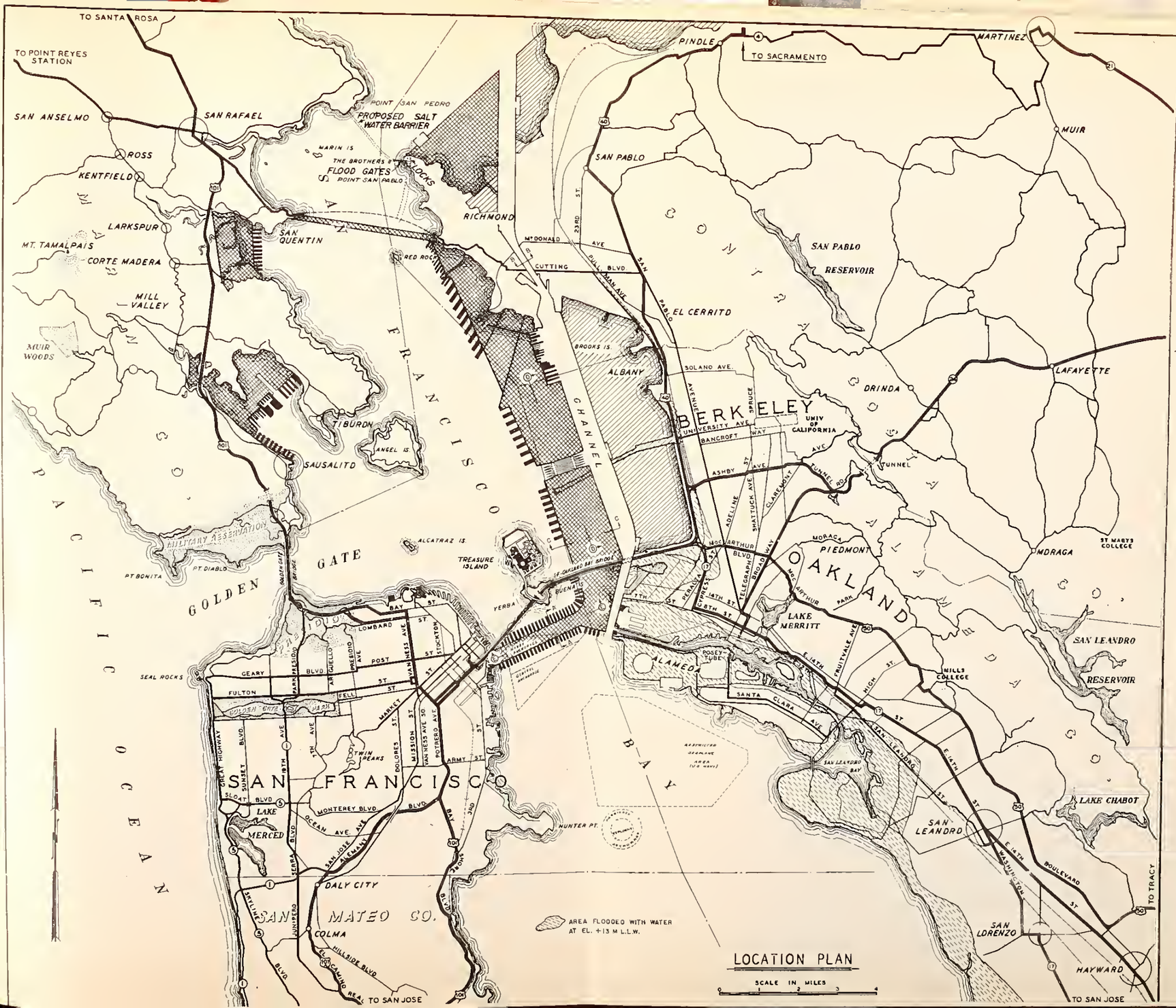
Passenger train miles - 300,000 @ $2.75	$825,000
Maintenance of facilities	1,000,000
Interest and amortization of investment @ 4%	2,400,000
	$ 4,225,000

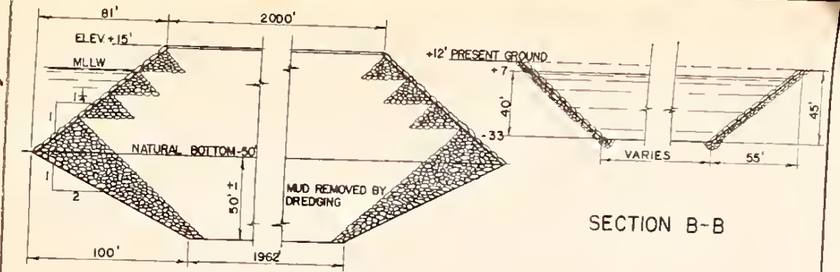
With an estimated 2,000,000 passengers annually on the Southern Pacific and Santa Fe, it would be necessary to add over $2.00 to the average passenger ticket to break even.

With four trains daily, the Western Pacific presumably would be forced to split its trains at the east end of the bridge or to proceed into Oakland and back out. This complication has not been considered in the above estimate.

The above estimate has been limited to passenger traffic. As explained above, the Southern Pacific has satisfactory facilities for freight so, from this standpoint, presumably the Southern Pacific has no interest. The estimated cost of the rail approaches on both sides of the Bay were for passenger traffic only, and would have to be increased in case Santa Fe and Western Pacific freight were to cross the Bay. From the similar conditions in New York Harbor, there appears no chance that the savings in operating costs of the bridge facilities as compared with those of the existing car float facilities would be sufficient to amortize any considerable investment.

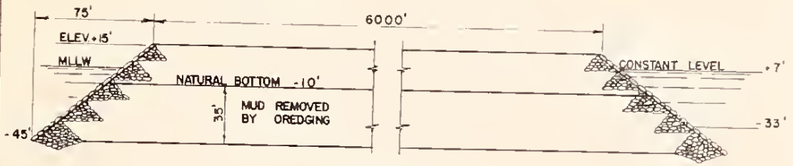
PLATE V





SECTION B-B

SECTION A-A



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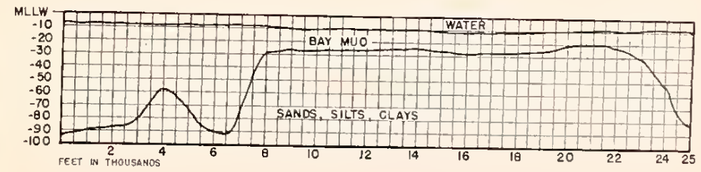

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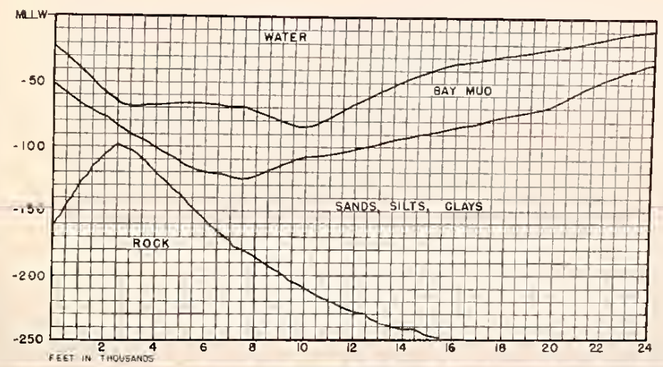

SECTION E-E

NOTE:— THE REBER PLAN, SHOWN CROSSHATCHED ON THE LOCATION PLAN, IS REPRODUCED FROM A DRAWING IN "WESTERN CONSTRUCTION NEWS", MARCH, 1942.

THE SECTIONS WERE DEVELOPED BY WOODRUFF & SAMPSON FOR THE ESTIMATES APPEARING IN THE REPORT. EXISTING FOUNDATION DATA WERE DERIVED FROM BEST AVAILABLE SOURCES, BUT BECAUSE OF LACK OF BORINGS ALONG SECTIONS THEY MUST BE CONSIDERED AS APPROXIMATIONS ONLY.

ALAMEDA COUNTY COMMITTEE FOR THE SECOND BAY CROSSING

THE REBER PLAN

WOODRUFF & SAMPSON ENGINEERS

VI THE SO-CALLED REBER PLAN

San Francisco Bay with its area of 420 square miles is one of the finest harbors of the world and it is largely for this reason that the Bay has become the principal harbor of the Pacific. Nevertheless, there is before the Joint Army-Navy Board a fantastic proposal, the so-called Reber Plan, which would reduce the area of the Bay by nearly ninety per cent and reduce the waterfront available for development from 350 to 35 miles. The only definite information concerning this scheme (Plate V) is that published by Western Construction News (9), Pacific Marine Review (10) and Engineering News-Record (11).

By its immensity this project has aroused public interest to an extent that has diverted attention from feasible plans for additional crossings of San Francisco Bay. It is anticipated that at this hearing before the Joint Army-Navy Board sufficient data will be presented to demonstrate, beyond all question, that the Reber Plan fails to meet the needs of the present situation. The following analysis is presented as evidence to that effect. Alameda County trusts that the findings of the Board in this respect will be so conclusive that all interested parties may unite in developing a plan for crossing the Bay that will be in the best interests of the entire area.

Salt Water Barrier

In its conception the Reber Plan may be considered as a major enlargement of the salt water barrier, which has received very careful investigation by the United States Army Engineers, the United States Bureau of Reclamation and the Water Resources Division of the California Department of Public Works. The records of these investigations (12), (14) and (15) furnish considerable data as to the costs, both capital and annual, involved. This information is so pertinent that a brief summary may be made before discussing the more comprehensive so-called Reber Plan.

Since these reports have such a material bearing on the present case, it appears advisable to establish their reliability. Mr. Hyatt has been State Engineer for many years and may be regarded as the sponsor of the vast Central Valley Project. Mr. Young, largely on the basis of his work on the Central Valley Project, is now Chief Engineer of the U. S. Bureau of Reclamation. The findings and conclusions of these reports were endorsed by a consulting board composed of leading engineers. These reports led to the adopted plan for the Central Valley Project, one of the largest of all times. The findings of reports (12), (14) and (15) may be considered conclusive.

Several locations were considered for the salt water barrier, the most southerly being that at San Pablo Point (Plate V). The width of San Pablo Strait is approximately two miles as compared with the four-mile spillway of the Reber Plan. The cost of the salt water barrier in 1931 was estimated at $75,000,000

Additional for salt clearing locks 7,000,000

$82,000,000

The annual costs of the salt water barrier were estimated at

Annual charges - physical works	$7,080,000
Detriments or losses	1,050,000
	$8,130,000
Benefits or savings	130,000
Net annual cost	$8,000,000

The salt water barrier, at most, would be the equivalent of 20% of the Reber Plan. On this rough approximation, the annual charges against the Reber Plan would be $40,000,000.

The summary of the report (14) ends as follows: "The final conclusion of this investigation of a salt water barrier located at any of the three typical sites is that this structure is not necessary or justified as a unit of the State Water Plan."

Studies in connection with the salt water barrier develop certain facts which are applicable to the Reber Plan.

1. Any project to create fresh water lakes under existing conditions is extremely experimental. The salt water incursions into Miraflores Lake of the Panama Canal and into Lake Union at Seattle are striking examples of the ease with which salt water contamination takes place even where the upper or supposedly fresh water pools are many feet above the lower or salt water pool. There are numerous other examples. Salt water clearing locks have never been used and there are many features of their operation that involve uncertainty.

2. The structure is undesirable because of:
   (a) Delay, increased costs and risks due to lockage, the latter especially in foggy weather.
   (b) Increased silting both above and below the barrier.
   (c) Increased cost of sewage and storm water disposal.
   (d) Destruction of the fishing industry above the barrier.
   (e) Damage to low lands and to existing improvements along the waterfront.

Reber Plan

The analysis of the Reber Plan, which follows in some detail, warrants the following conclusions:

1. Even if it could be constructed without cost, the Reber Plan would not result in a desirable development of San Francisco Bay.

a. It would destroy a large part of the existing harbor installations which have demonstrated their efficiency and suitability for their intended purpose. These installations represent investments of many millions and are pledged as security for outstanding obligations.

b. It does not fit plans for future development of harbor and other facilities which are being planned to coordinate with the Master Plans of the areas on both sides of the Bay.

c. By reason of loss of time, increased cost and navigation hazards, ships will use locks only when unavoidable. From a practical standpoint, the Reber Plan would reduce the shore line area available for development from 350 to 35 miles. The waterfront property behind the locks would be reduced to only a fraction of its present value.

d. The evaporation and transpiration losses from the fresh water lakes would require vast quantities of make up water urgently needed for the best development of the Central Valley and the Bay Area.

e. Because of the heavy concentrations of traffic at either end, the Reber Plan does not provide a satisfactory solution for another vehicular crossing of the Bay.

f. It would destroy several industries now established in the north and south ends of the Bay, including fishing, salt and others.

g. It would greatly increase operating costs in the harbor, including:

Dredging of navigable channels, especially the bar outside the Golden Gate.

That of the limited commerce which, because of existing installations, would still pass through the locks.

h. It would greatly increase the cost of sewage treatment and disposal in all areas behind the dams and also necessitate construction of new storm sewers and pumping plants. In both cases, considerable continuing operating costs would be involved.

2. The military authorities are in better position than the writer to assess its effect on the many Army and Navy installations. From a layman's standpoint, it would not seem desirable that these installations, such as the two naval yards and the supply depots, should be behind locks or that, should the fleet be called to sea in any emergency, it should have to pass through locks.

3. The cost of the Reber Plan, including damages, rather than the $116,700,000 given by its proponents, would be in the general order of two and one-half billions.

4. Practically all of the purported advantages, with the exception of the "fresh water" lakes, can be obtained at less cost by other means.

5. The engineering feasibility, especially in regard to the fresh water lakes, may be questioned.

Level of Fresh Water Lakes

The first question that arises is that of the surface elevation of the "fresh water" lakes. The Reber Plan provides for the regulation of this level by the flood control spillway extending from Richmond to San Quentin Point. To prevent salt water from overflowing the spillway in a reverse direction, the crest of the spillway would have to be above high tide a sufficient distance so that there would be no appreciable reverse flow with the combination of a high tide and a wind from the south. With a high tide at Elevation + 7.0* and a three-foot allowance for wind and wave,

*Throughout this section of the report, elevations will be referred to the datum of Mean Lower Low Water - 0.0.

the crest of the spillway would be at Elevation +10.0. (The similar elevation recommended for the salt water barrier was between +14.0 and +18.0.) The maximum flood at this point prior to the construction of Shasta Dam was 780,000 second feet. The maximum floods at this point occur principally from runoff on the Feather and American Rivers, the Shasta and Friant Dams having only a minor effect on major floods. Provision would have to be made to pass a flood of about 700,000 second feet. With a four-mile clear spillway, the depth of water over the spillway would be approximately 4 feet or raising the water surface to Elevation +14.0. The water in the south lake would be raised to practically the same elevation.

In this connection it should be noted that, contrary to the claims of Mr. Reber, the plan makes no storage of water available for use during the dry season. As soon as the spring floods are over, the evaporation and transpiration losses start and must be made up from other fresh water supplies.

The effects of raising the water to Elevation +14.0 would be:

1. The destruction of all levees in the San Joaquin and lower Sacramento deltas. For this and other reasons the State Division of Water Resources (hereinafter referred to as the Division) concluded (15) that the construction of a spillway was impractical and, rather than a spillway, placed gates to pass all floods. Their conclusion was to keep the lake level not less than two feet nor more than three feet above mean sea level, or at Elevation +6.0 to +7.0. Even at this lower level the Division estimated the increased maintenance of these levees at $120,000 per year. This is in addition to the increased cost of pumping from the drainage areas behind the levees.

2. The flooding of immense areas (in the case of Elevation +14.0), many of them highly developed, along the shores of the fresh water lakes. Plate V indicates the areas in Alameda County that would be flooded under these conditions, unless undesirable levees were constructed.

3. In addition, a very considerable rebuilding of the storm drainage system and a system of pumping plants would be required.

The Engineers of the Cities of Alameda County and the County Surveyor have furnished the following estimates:

Levees and seawalls	$200,000,000	
Channel protection and pumping plants	$ 40,000,000	$240,000,000
Annual operation charges		$ 1,500,000

From the above it is evident that, to make the plan workable, one of the several modifications would be to replace the proposed causeway between Richmond and San Quentin by a salt water barrier with flushing gates. The most economical location for such a barrier would be between Point San Pablo and Point San Pedro as proposed by the Division. In this case, the Division recommends a very close control of the water level between Elevation +6.0 and +7.0. This change would result in an estimated cost for this part of the Reber Plan of $160,000,000, provided locks were to be placed at this location. With the single system of locks as proposed opposite Berkeley, the approximate cost of the construction would be:

Unwatering	$ 14,000,000
Flood channel	6,000,000
Control works	8,000,000
Rock and earth fill	22,000,000
Total	$ 50,000,000

For the balance of this discussion, it will be assumed that the elevation of the fresh water lakes will be at +7.0.

Causeway - San Francisco to Oakland Mole

The Reber Plan proposes a causeway 2,000 feet wide (at the top) from the San Francisco waterfront to the Oakland Mole. At the east end of this causeway there would be a system of tunnels for vehicular and rail traffic to pass under the "fresh water" channel along the existing Oakland waterfront. The plan calls for four six-lane roads. The usual practice in such structures is to use two lanes per tube, requiring twelve two-lane tubes. It is assumed that the railroads would require two double-track tubes, (or four single-track tubes, the latter being the usual construction for railway facilities), making a total of fourteen tubes. As a basis for an approximate estimate, comparison will be made with the Posey Tube under the Oakland Estuary. This tube was built in 1925 at a contract price of $4,600,000. On the basis of present day prices, this cost would be increased to approximately $9,000,000. In 1940 an estimate (8) of a parallel tube was made, in the amount of $6,261,000. To meet present prices, this estimate would have to be raised to about $9,000,000.

In the case of the Reber Plan, some saving would result from building fourteen tubes rather than one. The railroad tubes would not require ventilation, if electric power was used. However, taking all these matters into consideration, there appears no possibility that these tubes could be built for less than $7,000,000 each or, in round figures, $100,000,000 for the fourteen tubes. However, the investment for electric motive power would involve a considerable capital investment.

To estimate the cost of "earth and rock dam" certain assumptions must be made. The following averages appear reasonable; if anything they are on the low side insofar as cost estimates are concerned:

Present depth of water	50 feet
Depth of bay mud	50 feet

Plate V shows an assumed section of the dam. For comparison, reference is made to Sheet 3 of the Joint Army and Navy Board Report (3) and to the east approach of the Bay Bridge. (5). In the case of the former, there is an excellent sand deposit near Bay Farm Island, so that extensive predredging would not be essential. In the case of the Bay Bridge approach, the amount of dredging was limited because of the adjacent Key Route Mole. Experience with maintenance of the approach has demonstrated that deeper pre-dredging would have been desirable.

The additional load which would be placed on the soil underlying the bay would be in excess of two tons per square foot. From the records of borings in the Hoover-Young Report and from experience during the construction of the Bay Bridge it is certain that, on the average, there

would be no strata above Elevation -100.0 that would support this load without excessive settlement. For comparison, pre-dredging was carried at some points to Elevation -100.00 at the Hunter's Point Naval Drydock to support similar loads.

On the basis of this section and a length of 18,000 feet the quantities involved are given in the estimate which follows: The proper unit prices which should be applied to such immense quantities present difficulties which could be answered only by an investigation beyond the scope of this report. The mud which must be dredged may be considered useless. In the case of the Bay Bridge, the Army Engineers permitted the wasting of the material directly north of the fill, with a resulting low price. In order to arrive at the lowest possible estimate, it is assumed that the Army Engineers would permit wasting of this material directly south of the dam. In the case of the east approach of the Bay Bridge and for the construction of Treasure Island, sand was available nearby for the hydraulic fill. The amount of sand available in the Bay for such fills is limited. For this reason, in reclaiming land for the fills at the San Francisco Airport, material was hauled in 1944 to the site from the hills at a cost of 78 cents per cubic yard. Recently (San Francisco Chronicle, July 24, 1946) the Navy was negotiating for sand fill at Hunter's Point at a price between 80 and 90 cents per cubic yard.

Unit costs for similar work on the east Bridge approaches in 1934 are shown by the following tabulation:

Items	Quantity	Unit Price 1934	Unit Price 1946 Est.
Dredging	928,448 cu. yds.	$0.0698	0.10
Sand fill	3,823,728 cu. yds.	0.1998	0.30
Face rock	40,407 tons	1.60	2.50
Core rock	31,293 tons	1.05	1.50

With the large quantities involved there would be some decrease in unit prices. Pending a complete investigation of all sources of material, we believe the minimum estimate for the construction of the dam is:

Dredging and disposal	50,000,000 cu. yds. @	0.10	$ 5,000,000
Sand fill (or equivalent)	140,000,000 cu. yds. @	0.50	70,000,000
Face rock	600,000 tons @	2.00	1,200,000
Core rock	3,000,000 tons @	1.30	3,900,000
Paving 24 lanes	18,000 lin. ft. @	200.00	3,600,000
Railroad (4 tracks)	18,000 lin. ft. @	50.00	900,000
Tubes			100,000,000
Total for the dam - construction only			$184,600,000

or approximately $185,000,000.

The next section to be considered will be that parallel to the Berkeley waterfront.

The Division (14) in 1931 estimated the cost of the locks at San Pablo Point at $30,000,000. At present cost levels, this estimate would have to be raised to at least $50,000,000. The next consideration is that a considerably greater capacity would be required for the proposed location than for the salt water barrier at San Pablo Point. The following statistics are from the 1940 Annual Report of the Chief of Engineers, U. S. Army:

San Francisdo Docks	6,314,100 tons
San Pablo Bay and East	9,526,866 tons
Richmond and Oakland	13,074,494 tons
South Bay	1,916,831 tons
	30,832,291 tons

From the above tabulation, about twenty per cent (20%) of the Port traffic would have to pass through the locks of the Salt Water Barrier. With the Reber Plan all of this traffic, except possibly two-thirds of that destined to San Francisco Docks, or over eighty per cent (80%) of the Port traffic would have to pass through the locks. On this basis the capacity of the locks would have to be at least doubled, resulting in an estimated cost of $100,000,000 for the locks. Even this estimate makes no allowance for the greater depths that would be required at Berkeley to reach a satisfactory foundation.

This estimate is subject to challenge to the extent that, as hereinafter shown, the costs and delays incident to this lockage would drive business from all parts of the Port behind these locks. On this basis, provision for the normal growth of commerce at Oakland, Richmond and other ports in the "fresh water lake" might not be justified.

An average section for the filled construction along the Berkeley waterfront between the Oakland Hole and Richmond is shown by Plate V. In this section no consideration is given to the section east of the fresh water channel. This area is largely in private ownership, plans have been made for its improvement, and it will be reclaimed as soon as it becomes economically justified to do so. It is therefore no part of the Reber Plan, except insofar as this property is benefited or damaged by such plan. The section considered is therefore the section to the west of the channel, averaging 6000 feet in width and 38,000 feet in length.

The borings in this area of which we have record are:

(a) Those of the east crossing of the Bay Bridge, which give:
Water to Elevation - 20.0
Soft bay mud to Elevation -40.0

(b) Those of the Berkeley Waterfront Company, which show that, before subsidence of the area the topography was rather rough, traversed by sloughs. In these old sloughs, the material is very soft to depths of 100 feet.

The estimate for this section is

Dredging and disposal	310,000,000 cu. yds.	@ 0.10	$ 31,000,000
Sand fill or Borrow	520,000,000 cu. yds.	@ 0.50	260,000,000
Face rock	1,200,000 tons	@ 2.00	2,400,000
Core rock	3,200,000 tons	@ 1.25	4,000,000
Navigation locks			100,000,000
Total - construction only			$397,400,000

or approximately $400,000,000.

It is believed this estimate errs considerably on the low side. In the investigation for improving the Berkeley waterfront it was found that there was not a sufficient volume of suitable material to reclaim the area east of the proposed channel. Probably for the fill west of the channel, fill would have to be imported. In this case, the cost of the fill would be double the figure shown. The only protection estimated for the fill is the slope paving. Presumably for a harbor development as proposed the Army Engineer would establish a bulkhead line along which a sea wall or concrete and pile bulkhead would be erected. The cost of such construction would be materially higher than the slope paving shown by the section and included in the estimate.

There is another item of major expense for this section of the Reber Plan which, because of its importance, is treated separately - the re-building of the east crossing of the Bay Bridge. The east bank of the proposed fresh water channel is approximately at the point where the present bridge reaches grade. At this point, under the Reber Plan, a crossing with the upper deck at Elevation 240.0 would be required. Maintaining the 2.74 per cent grade adopted for the present bridge, the upper deck roadway would come to grade at a point 8200 feet east of the channel, or 2000 feet west of the distribution structure. Presumably a high level crossing immediately east of Yerba Buena Island would be required, resulting in a high level bridge the entire distance between Yerba Buena Island and the fresh water channel.

Among the adverse effects of such a proposal are that:

(a) The present toll collecting and administration facilities would be eliminated. There would not be sufficient room to restore such facilities between the end of the approach and the distribution structure, at grade.

(b) Connections to the Port of Oakland overhead, leading directly to the military establishments in this area, would have to be reestablished at a high level.

(c) It would eliminate "Through" operation of the yard of the Bridge Railway and eliminate the very important station serving the military establishments.

It is believed that these objections by themselves are sufficient to remove the deep water channel along the Berkeley waterfront from further discussion.

A very approximate estimate of cost would be:

Rebuilding east crossing High level - 20,000 feet long	$ 50,000,000

Channel through Richmond

The channel through Richmond is assumed to be three hundred feet wide with a navigable depth of 40 feet below pool level. The length is approximately 16,000 feet. The estimated cost, assuming the most favorable conditions, would be:

Dredging and disposal	10,000,000 cu. yds. @ 0.10	$1,000,000
Slope protection	400,000 tons @ 2.00	800,000
Vehicular and railroad tubes		20,000,000
		$ 21,800,000

say $22,000,000

Shipyards of the Moore Dry Dock Company in the Oakland Inner Harbor, one of the important units along this valuable waterway, where many of the C-2 type cargo vessels were constructed during the war, and where much peacetime conversion and construction is going on

Water Supply

The water supply required for evaporation, transpiration and operational losses are shown by the following table. (See (14), Table 26.)

Required Rate of Flow During Summer Months

Demand	Second feet	
	Salt Water Barrier San Pablo Site	Reber Plan
Lockage and flushing	6,100	24,000
Gate leakage and fish ladders	350	350
Evaporation and transpiration	1,050	2,050
	7,500	26,400

As has been shown above, the number of vessels passing through the locks for the Reber Plan would be approximately four times that for the salt water barrier. The area subject to evaporation and transpiration would be doubled.

For purposes of comparison, the required flow of 26,400 second feet is 17 billion gallons per day. This is roughly thirty times the combined ultimate capacity of the San Francisco Hetch Hetchy (400,000,000 gallons per day) and the Mokelumne Supply (200,000,000 gallons per day) of the East Bay Municipal Utility District. In an average year it would require water in the amount of 680,000 acre feet. Flow from storage in the amount of 340,000 second feet is required to assure a stream flow sufficient to control salinity in the Sacramento Delta. This leaves a deficit of 340,000 acre feet for the Reber Plan. In years of minimum run-off, this deficit would be 1,400,000 acre feet. For a margin of safety, storage would have to be provided in the latter amount. This is practically thirty per cent of the storage capacity of Shasta Dam.

Assuming that the fresh water lake is the most beneficial use to which this water could be assigned, the cost of such development would be a proper charge against the Reber Plan. The cost of such development would be not less than $10,000,000.

Summary of Estimates - Construction

The above estimates and rough approximations for other parts of the Reber Plan are shown by the following tabulation:

North Barrier	$50,000,000
Dam, San Francisco to Oakland Mole	185,000,000
Dam along Berkeley Waterfront	400,000,000
Changes to Bay Bridge	50,000,000
Richmond Channel	22,000,000
Additional Water supply	10,000,000
100 Harbor Piers - $4,000,000 average	400,000,000
Rail and vehicular terminals - San Francisco	30,000,000
" " " " - East Bay	10,000,000
	1,157,000,000
Contingencies	116,000,000
	1,273,000,000
Engineering	67,000,000
Interest during construction	160,000,000
Construction Cost	1,500,000,000

This estimate may be compared with that given in Section IV of this report for development of Oakland Harbor. With an estimated construction cost of approximately $200,000,000 for a very modest program as compared with the Reber Plan, the estimate of $1,500,000,000 for the latter does not appear unduly high.

This estimate does not include the following features of the Reber Plan:

a. Torpedo boat base site.
b. Submarine base site.
c. Reclamation of areas north of Richmond
d. Industrial site along the Berkeley waterfront east of the channel.
e. Any development of the surface of the reclaimed areas except paving of 24 vehicular lanes and constructing 4 main line tracks on the dam between San Francisco and the Oakland Mole.

Effects on Sewage Disposal

The effects on the sewage disposal project of Special District No. 1 (as estimated by John S. Longwell, General Manager) would be extremely serious and costly. These may be summarized as follows:

"1. Disturbance of the normal tidal currents in San Francisco Bay. These currents are depended upon for dispersal of the sewage effluent. The strong currents on the easterly side of Yerba Buena Island have been found by investigations to be ideal for this purpose. In case a dam were built across the bay just south of the Island as proposed under the Reber Plan, the natural currents would be interfered with and the sewage disposal project as now planned would not be successful.

"Present plans call for the discharge of the effluent from the treatment plant into the deep waters of the bay about 6000 feet offshore from the end of the old Key Route fill. The treatment plant is to provide for primary treatment of the sewage. With the change of conditions as outlined in the Reber Plan, it would be necessary to provide for a complete treatment plant. It is estimated that the additional cost of such a plant would be approximately $16,000,000.

"2. In addition to the expense as listed under Item 1, it would also be necessary to arrange for the separation of all sanitary flow from combined sewers now planned to feed into the proposed intercepting sewers of the sewage disposal project. This procedure would be necessary for the reason that it would not be feasible to discharge any surplus combined sanitary and storm water flows from the treatment plant into the "fresh water ship channel." The present design calls for overflow from the treatment plant discharging into the ship channel at the Port of Embarkation during periods of heavy storm water flow. It is estimated that the cost of separation of the sanitary flow from the storm flow would amount to approximately $3,000,000.

"3. The cost of the outfall from the proposed treatment plant would be substantially increased due to the necessity of carrying this outfall under the proposed fresh water channel. From this channel the effluent would then be carried through the outfall and discharged about 6000 feet off the end of the Key Route fill, or approximately at the location of piers shown on the sketch of the so-called Reber Plan."

Aerial photograph of the Navy's $100,000,000 Oakland Naval Supply Depot in Oakland's Middle Harbor, which, with its sub-bases, stands as the world's largest Naval Supply Depot

Property and Damages

The estimate of construction cost is relatively simple compared to estimating the cost of property to be acquired and of damages to other property. No attempt will be made to do more than to establish the general order.

All shipping destined to the Alameda-Contra Costa County cities, San Pablo Strait and north, to the San Francisco Harbor south of the channel and to all points south of San Francisco would have to pass through locks. The operating costs resulting from the delay through the locks and the increased insurance resulting from the increased navigation hazards would deter all shipping from using the present facilities, with the result that the values of these properties would decline materially.

The present value of the public and private facilities in Oakland harbor, exclusive of military establishments, is estimated at about $150,000,000. Including all waterfront property behind the dams, the corresponding estimate would be $400,000,000. In the writer's opinion, the damages to these facilities would be not less than $200,000,000. The project involves the acquisition of San Francisco Harbor Piers 26-48, accommodating the Matson, American-Hawaiian Lines, now valued at about $16,000,000.

The storm sewers in all the cities on the east shore of the Bay, are now inadequate. The establishment of a pool at Elevation +7.0 would adversely affect the hydraulic gradients. The city engineers of these cities estimate new construction in the amount of $12,000,000 would be required to meet the proposed conditions.

The land and improvements that would be required for terminals and approaches on both sides of the Bay would be in the general order of $15,000,000.

The channel through Richmond would destroy the Santa Fe Terminal and wipe out several other important industries.

Other items are:

Destruction of the fishing industry in the upper Bay.

Destruction of the salt industry on the east side of the lower Bay.

Increased cost of sewage treatment and disposal throughout the Area, in addition to those above given for Special District No. 1.

In the aggregate, it seems probable that the damages, exclusive of those to military installations, would be not less than $1,000,000,000. Adding this to the estimated construction costs, we believe that the minimum cost of the Reber Plan would be $2,500,000,000 and that annual charges against the installation would be not less than $100,000,000.

Silting

One of the many objections to the Reber Plan is that of increased expense of dredging to keep the various navigable channels at their proper depth. At present, average annual expenditures by the Army Engineers in the San Francisco District for this purpose are $800,000.

Under present conditions a large part of the silt coming down the Sacramento and San Joaquin Rivers is carried by the tides through the Golden Gate. Under the Reber Plan, this would mostly be deposited in the various channels behind the dams.

Outside the Golden Gate there is a crescent-shaped sand bar, 80,000 feet in length with a radius of 18,500 feet. In its natural condition the top of the bar has an average depth of 32 feet below mean lower low water. To maintain navigable channels frequent dredging is necessary, the Army Engineers spending, on the average, about $60,000 annually for this purpose.

The present natural elevation and location of the bar is controlled by the tidal flow through the Golden Gate. In case the volume of this flow is reduced by any reason the bar will move closer to the Golden Gate and the depth of the water over the bar will become decreased. With the Reber Plan, the volume of the tidal prism will be reduced to approximately 15 per cent of the present flow. This would entail either (a) a material increase in the cost of dredging or (b) the construction of an extensive and expensive system of jetties. This matter has been studied to some extent by Dean M. P. O'Brien (18) of the University of California.

Fresh Water Lakes

Some reference has been made in the above to the uncertainty of any proposal for the fresh water lake and the unsatisfactory results that have been achieved at other locations. The Division's conclusion was that with the salt water barrier at Point San Pablo and with the utmost precautions in design, construction and operation, fresh water, north and east of the dam, could be maintained. In this case fresh water coming down the river would have a natural tendency to flush out salt water through the gates provided for that purpose.

An entirely different condition prevails at the south end of the Bay. The run-off into the Bay is negligible. Water flowing through the channel along the Berkeley waterfront would have no tendency and in fact no chance of clearing out the salt water. For these reasons, it appears that transforming the south Bay into a fresh water lake would be most difficult and involve construction and costs which have not been included in the above estimates.

In the above, an effort has been made to analyze fairly the engineering features of the Reber Plan and to estimate the probable costs of construction. With a project of this magnitude, many times that of the Panama Canal, a detail analysis and complete investigation of all major construction has been impossible. Some generalities may be worth consideration.

San Francisco Bay is one of the finest harbors of the world. The port facilities on both sides of the Bay, including warehouses, railroad yards, etc., have been developed as rapidly and to as great an extent as economically justified. These facilities were put to a severe test during the late war. The results speak for themselves. Both sides of the Bay have plans for major additions to the present facilities. Those in charge of such development believe that there are no advantages in the Reber Plan; in fact they believe most strongly that the opposite is true.

A modification of the Reber Plan has been suggested (11) whereby only the South Dam of the Reber Plan would be constructed at this time, at an estimated cost of $100,000,000. This proposal and estimate will be considered briefly. This would necessitate the building of the locks in this section of the dam with the vehicular and railway tubes passing under the locks.

Insofar as is known there is no foundation stratum above rock on which such a structure could be founded. Foundation borings along this line have never been made. From the information in the Hoover-Young Report (2) and the borings for the Bay Bridge it may be assumed that a caisson (or combination of caissons) or similar construction with an area approximately 600 feet by 1000 feet will be required. Insofar as the writer is aware, the largest caisson as yet constructed is that for the central anchorage of the Bay Bridge, 92 feet by 197 feet, or roughly three per cent of the required area. Such construction or its equivalent might, and probably would, be possible. It would certainly be expensive.

Until a workable solution of some of the major difficulties is presented, no accurate estimate is possible. The estimate given above of $200,000,000 for the dam plus $100,000,000 for the locks, or a total of $300,000,000 for the crossing, without any allowance for approaches on either side of the Bay, is believed a minimum.

Another proposal has been made to construct a combination of subaqueous tubes and causeway. This has been discussed above and dismissed on the ground that the interferences with free navigation, including increased tidal velocities through a restricted channel, make such proposed construction detrimental to the best interests of the Bay Area.

VII ACKNOWLEDGMENT

This report is largely a compilation of data from various sources. An attempt has been made to give proper credit for such sources. Published reports of the California Toll Bridge Authority have been used freely.

The Consulting Engineers express their appreciation of the assistance of the Alameda County Committee for a Second Bay Crossing and to the Engineers' Advisory Committee. The members of both committees have given freely of their time to discuss the report and to furnish data therefor.

Photographs used in the report were furnished through courtesy of the Oakland Port Commission. All of them are by Clyde H. Sunderland with the exception of the two facing Pages 53 and 55 respectively. The photograph facing Page 53 is by Gabriel Moulin while that facing Page 55 is furnished through courtesy of the U. S. Navy.

APPENDIX I

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Note: No attempt has been made to furnish a complete bibliography of the many proposals for crossing the Bay. Only those to which reference is made in this report are included.

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HOWARD TERMINAL

NINETY-FIVE MARKET STREET • OAKLAND, CALIFORNIA

August 12, 1946

THE JOINT ARMY-NAVY BOARD INVESTIGATING
THE NECESSITY FOR ADDITIONAL CROSSINGS
OF SAN FRANCISCO BAY

Gentlemen:

Our Company has been operating here at its location on Oakland's Inner Harbor for forty-six years, having been organized in September, 1900. We operate on 17½ acres, fully developed for deep water shipping and shipside warehousing involving a conservative value of $2,000,000.00.

Owing to our years of experience, and thereby the opportunity afforded in watching the growth of shipping activities on this east side of the Bay, we strongly register our objections to any type of Bay crossing that would effect the free access by vessels to deep water facilities here. This area is also constantly increasing in industrial activity which in turn requires increasing facilities for cargo tonnage - inbound and outbound.

During the recent War years, our Terminal was used to capacity in the handling of cargoes as were all other facilities here. Now in peace time we are again working to capacity. These much needed facilities, in war time and in peace time, must not be endangered by the construction of types of Bay crossings such as the Reber Plan presents. We speak not locally or selfishly but in behalf of the whole of San Francisco Bay and for the future commerce it must accommodate. New Bay crossings are necessary, but not of the kind that retard shipping.

We have reviewed the Report of the Alameda County Committee for a Second Bay Crossing and fully approve of its statements and findings, and by this letter wish to so record such approval.

Respectfully yours,

Chas. P. Howard

Chas. P. Howard, President

CPH:EMT

HOWARD TERMINAL

ENCINAL TERMINALS

ON SAN FRANCISCO BAY
MAIN OFFICE
TERMINALS AND WAREHOUSES
ALAMEDA, CALIFORNIA
PHONE LAKEHURST 3-1311

August 12, 1946

THE JOINT ARMY-NAVY BOARD INVESTIGATING
THE NECESSITY FOR ADDITIONAL CROSSINGS
OF SAN FRANCISCO BAY

Gentlemen:

Encinal Terminals is a deepwater terminal and warehouse facility situated in Alameda, an island, separated from Oakland by the Oakland Estuary, on the mainland side of San Francisco Bay.

The total berthing space provided will accommodate 5 large ocean-going vessels at one time. The three transit sheds contain 300,000 square feet of covered space, and there are in excess of one million feet of open storage space provided.

There is sufficient waterfront property available to increase the present facilities some three to five times.

There are approximately 100 acres of land available to new industries which require tidewater plants. The total investment in land and buildings etc., is approximately $4,000,000.00

It is believed that upon construction of the facilities covered by the so-called Reber Plan, the above investment will be reduced very greatly and plans for potential increases in facilities and waterfront industries would be greatly injured or entirely killed, because all shipping destined to the facilities of Encinal Terminals would be forced to pass through locks which, it is felt, would deter such shipping from utilizing the deep-water facilities now provided here.

The Encinal Terminals, therefore, concurs in the objections of the Alameda County Committee for the Second Bay Crossing, to the so-called Reber Plan.

Respectfully yours,

ENCINAL TERMINALS

D. L. Dullum
Vice-President and
General Manager

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